10 CENTS

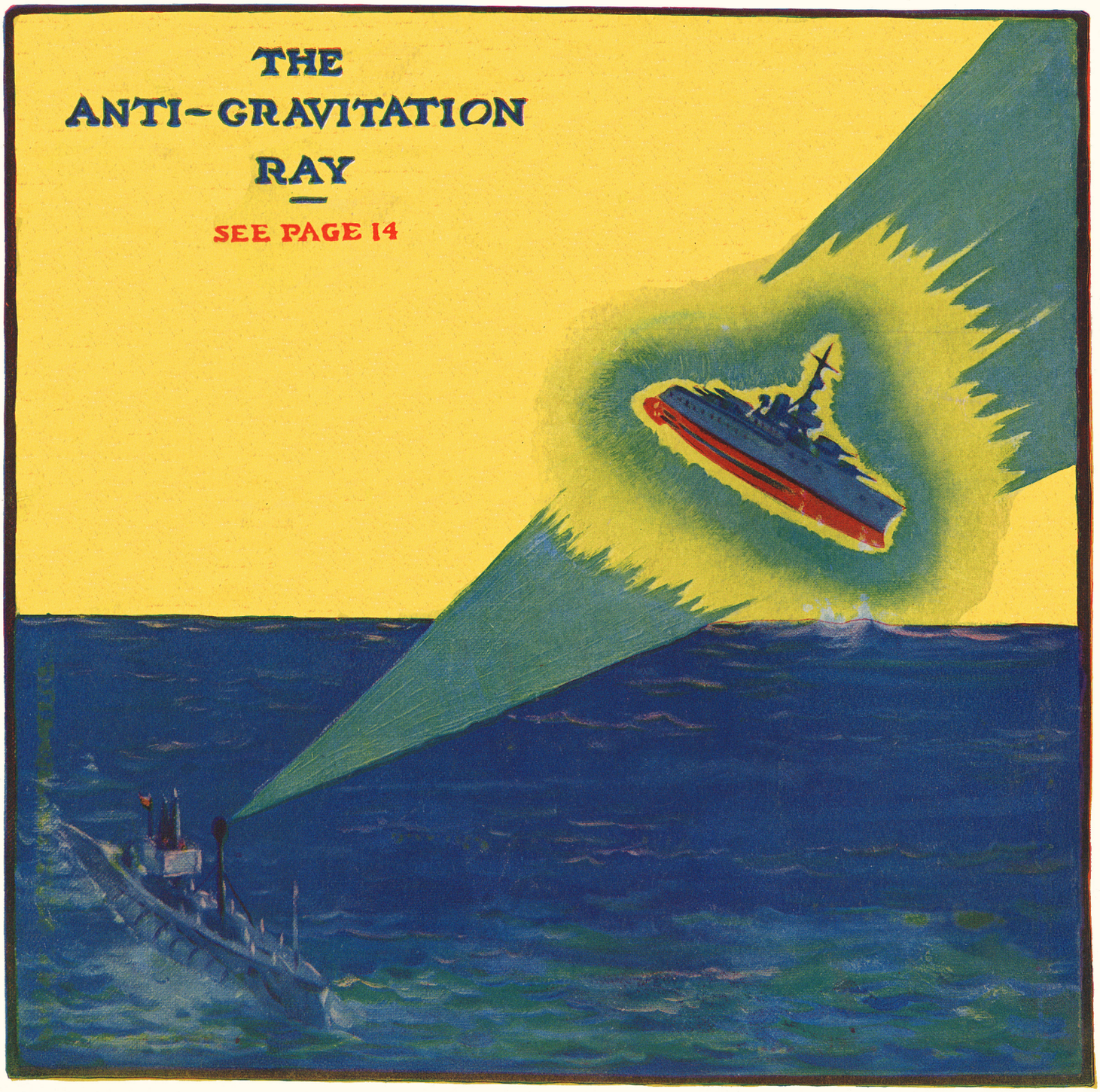
MAY, 1916

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

THE ANTI-GRAVITATION RAY

SEE PAGE 14



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4th. Anyone, either sex, if over 12 years old, may participate in the contest.
5th. Contest closes at 12 o'clock noon, June 30th, 1916, at which time the last subscription must be in our hands. The winner will be notified at once.
6th. Winners will be announced in our August issue.
7th. Subscription agencies are not eligible to compete.

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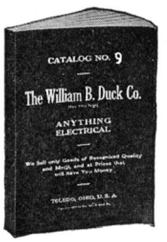

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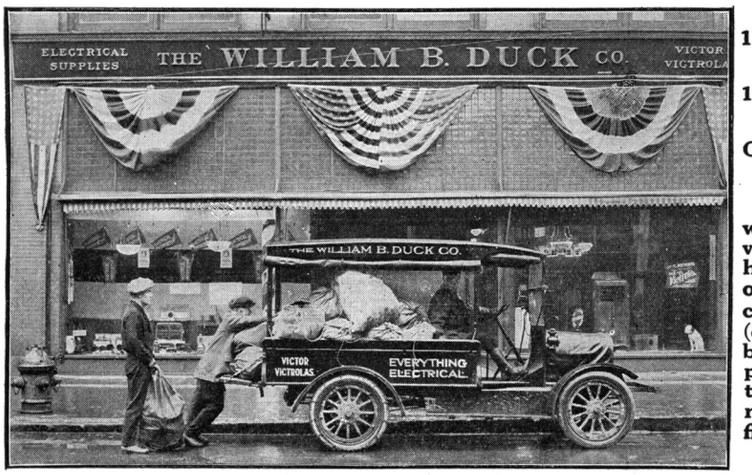

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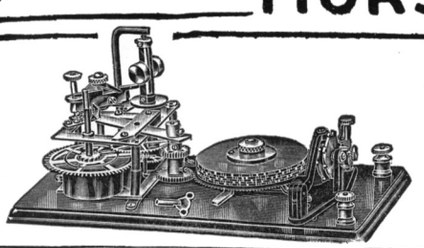

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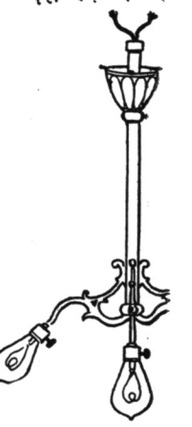

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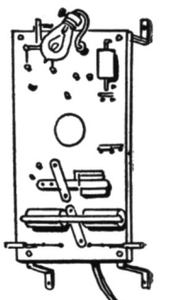

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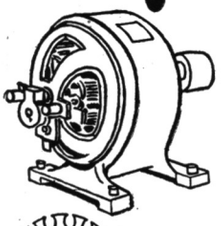

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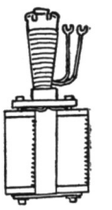

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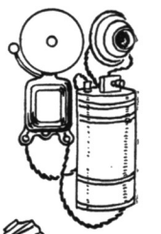

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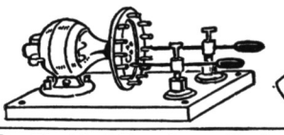

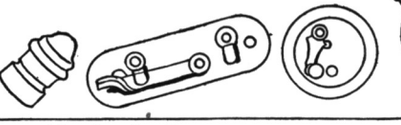

The Electrical Experimenter

233 Fulton Street, New York.

Published by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; M. Hymes, Secretary), 233 Fulton Street, New York.

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What to Invent

OF late, we are receiving a great many inquiries from experimenters, would-be inventors, inventors, as well as others, asking us to publish a "list" of useful electrical devices which as yet require to be invented. Most of our correspondents state that they are of an inventive turn of mind and quite a few admit very frankly that in the past they have lost a good deal of money and time in trying to develop ideas which afterwards turned out to be of no earthly practical use. By boiling down the various inquiries, this is what our correspondents desire: "What electrical inventions are urgently required at present, and which ones are the most desirable from a financial viewpoint?"

As most everyone is familiar with the important problems as yet unsolved, such as: Electricity direct from Coal; Harnessing of the Sun's and the Ocean's Energy; Cold Light, etc., we do not for the present wish to dwell upon these. For that reason the "list" which we suggest below will probably be more in keeping with our would-be inventors' desires. We make no claim that the suggestions are highly original, or that they could not easily be improved upon. We do, however, think that it would be quite profitable to invent and market any one of the ideas and devices cited. At least that is our humble opinion.

Wire Insulation. At present we use either cotton, silk, rubber, or enamel to cover wires. There is needed a covering, having all the good qualities of silk and cotton as well as enamel, but none of their bad ones, i.e., the insulation must take up a minimum of space, it must be tough and must not crack or break.

Storage Battery Casings. 98% of all portable storage batteries are now encased in wood. Wood is cheap and if well impregnated it is fairly acid proof for a limited time. As a whole the material, however, is not satisfactory. There must be something better. What is it?

Heavy Current Microphone. Wireless telephony is retarded at present because there is no practical transmitter that can handle from 5 to 10 amperes continuously. The microphone should be small and should not require water cooling, as this makes it highly undesirable. Preferably no carbon should enter into its construction.

Marble Substitute. There is an immense demand for instrument bases and parts, switch and switchboard bases, etc. At present very expensive marble, slate, wood or composition is used. Porcelain is cheap, but never presents a good appearance, especially for instrument bases. Marble dust is cheap and can be readily had in large quantities. Who will be the first *to mold* a real cheap marble base, that take a good polish? We are aware of the fact that artificial marble is in existence. It is, however, almost as expensive as the natural.

Telephone Muffler. A device is needed whereby you can talk into your telephone transmitter in such a manner that a person sitting close by cannot hear what you say. Every business office, for obvious reasons, can use such an attachment. At the present time the business man must use a cumbersome, as well as expensive, telephone booth. There have been telephone mufflers on the market in the past, but all died a quick death; there was just one trouble with them; they didn't muffle!

Tele-Music. An "industry" rivaling the moving picture business can be created when some genius perfects a means supplying telephone subscribers with all kinds of music from a brass band down to a violin concert. The requisites are that ten or 100,000 subscribers can listen in, all at the same time, without the sound weakening as more telephone lines are put in the circuit. The subscriber must be able to use his regulation instrument. No expensive attachments should be used; only, perhaps, let us say, a low priced horn, quickly attachable to the telephone receiver. The music should be heard loudly all over the room. No expensive nor complicated plant should be used at the point where the music originates. A two-wire line should connect the plant with "central."

These are only a very few suggestions. If required we will publish more from time to time.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

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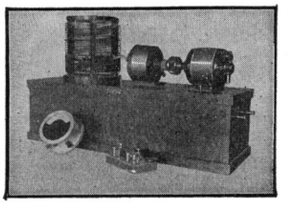

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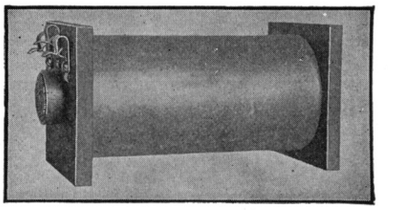

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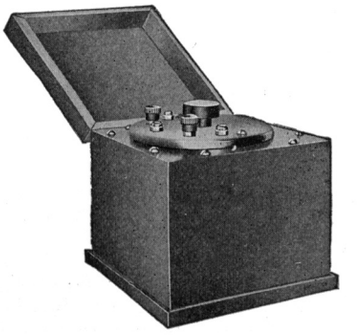

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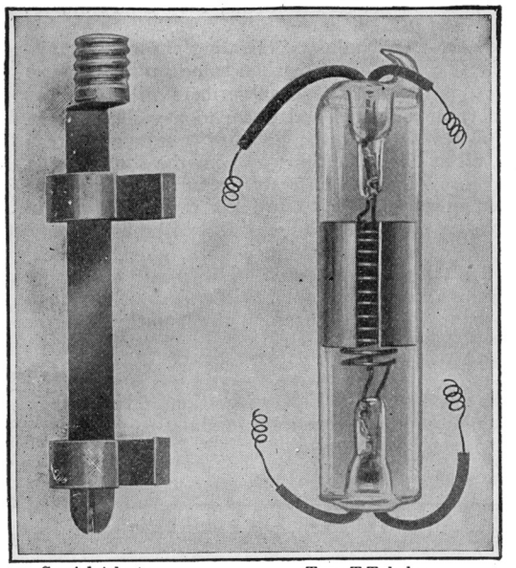

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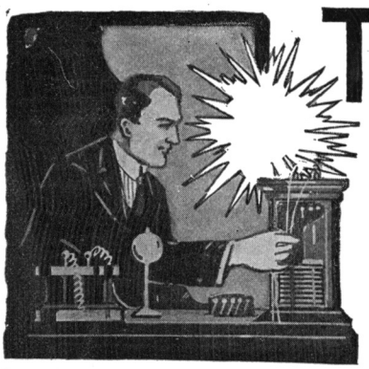


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 37 MAY, 1916 Number 1

Electric Gyroscopic Stabilizer for Ships and Aeroplanes

FOR many years the problem of reducing or preventing the rolling of ships has occupied the attention of prominent engineers and scientists in all parts of the world. Among them, and probably the first to make practical experiments in this direction, was Sir Philip Watts, who in the '80's placed damping tanks on English battleships.

Somewhat later Sir John I. Thornycroft, an Englishman, devised a stabilizer consisting of a large weight equal to about 5% of the ship's total displacement. By means of hydraulic control actuated by the ship's rolling, this weight, mounted in the hold of the ship, was shifted from side to side, partly counteracting the tendency to roll from side to side.

Recently Herr Frahm reinvented the damping tanks and installed some of them on several large ships. These tanks were shaped somewhat like a horseshoe and were partly filled with water, which surged back and forth as the ship rocked. This surging of the water tended to reduce the natural roll of the ship.

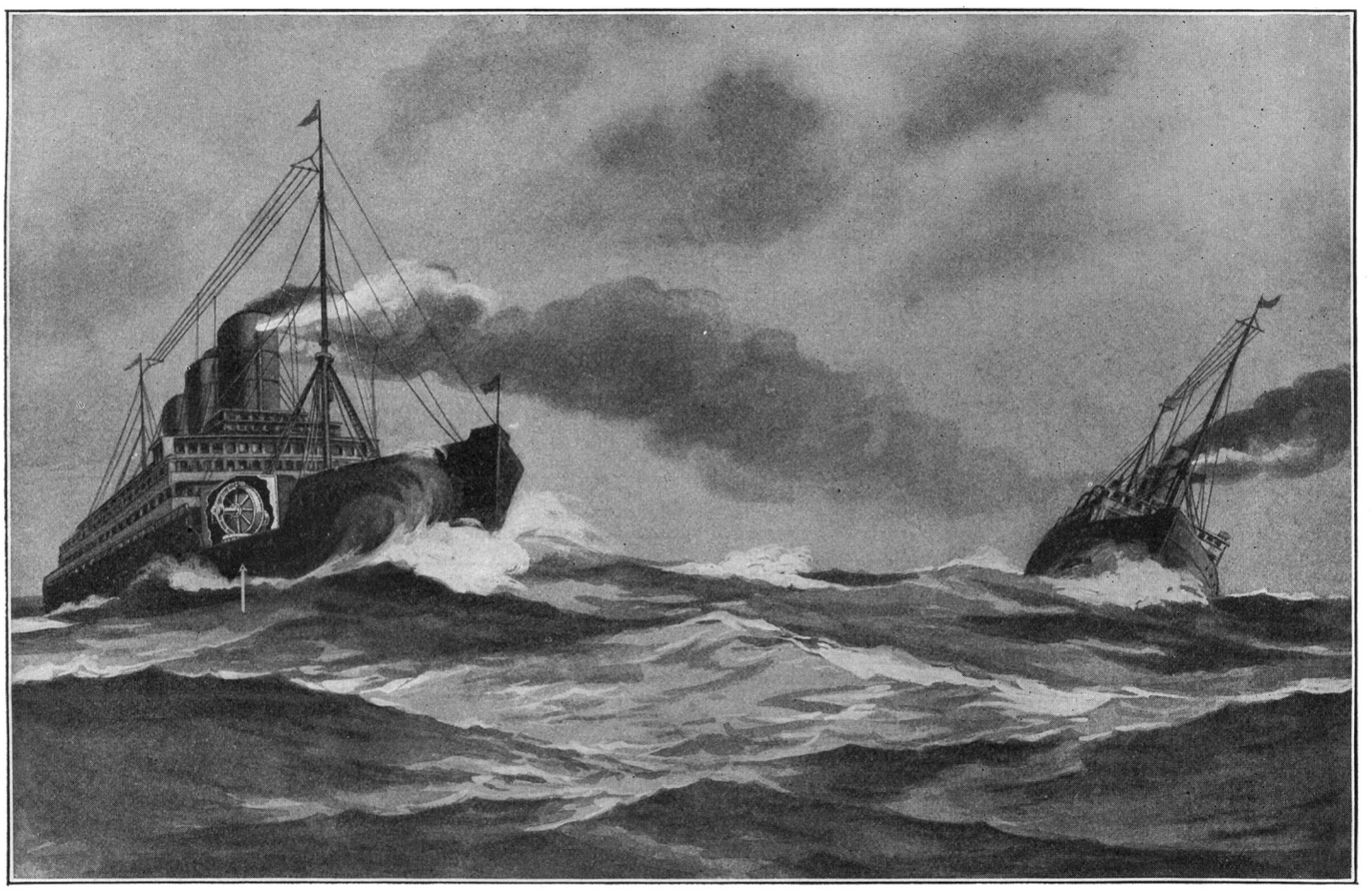
The gyroscope was first employed to stabilize a ship by Dr. Schlick, a German engineer, who mounted a large gyroscope wheel horizontally in the ship in a position to swing freely, with its shaft vertical. This constituted a "passive" gyroscope. The rolling of the ship tended to tilt the gyroscope out of its horizontal plane but the inertia of the spinning wheel opposed the motion with a reaction which tended to check the motion of the ship.

There were, however, weak points in these various systems, inasmuch as they were only partially effective in heavy seas.

It was left to Mr. Elmer A. Sperry, an American engineer, to perfect a stabilizer that will *actually prevent* a ship from rolling.

This has been accomplished by means of an "active" type of stabilizing gyroscope; that is, one in which the motions of an unassisted or "passive" gyroscope are simulated and greatly augmented by a precision (i.e. advance motion) motor. This motor is controlled by a small auxiliary gyroscope, equal to a pendulum some six miles in length. It will instantly detect the slightest roll of the ship and actuates the control of the precession motor, which, in turn, controls the large gyroscope. The inertia of the gyroscope prevents the rolling of the ship.

The principle upon which the gyroscope is employed in stabilizing such a vessel is that remarkable inherent quality of the gyroscope to create dynamic forces from pure static energy.



The Vessel at the Left Is Equipped with Stabilizing Gyroscope; Ship at Right Without Gyroscope is Floundering Through the Heavy Seas at All Angles.

This is easily illustrated by the little toy gyroscope, which, when spinning at high velocity, shows this reaction effect perfectly. The phenomenon of precessional movement passes through the whole range of 180 degrees by pure static pressure applied to the outer ring. Upon careful observation it will be found that this static pressure is almost free motion. When all of the joints are free and lubricated almost no motion whatsoever is taken on by the outer ring during the full 180 degrees precessional (i.e. advance motion) movement of the inner ring. Now, applying this to the ship, we find that while stabilizing it against heavy seas, the gyro-equipment is very active, as the dynamic forces of the gyro are opposing the dynamic effects of the sea. But as we have seen in our toy gyro, the greatest movements result entirely from static pressure transmitted to the device from the sea, through the structure of the ship, without the slightest necessity of motion on the part of the ship itself. The transmission is from the dynamic disturbance to the dynamic resistance through pure statics and for this reason it becomes entirely unnecessary for the ship itself to take on motion; it is only necessary for the ship to act as a medium for the transfer of static stresses of comparatively small magnitude and without motion.

The first gyroscopic stabilizing plant was placed on the U.S. Destroyer *Worden* (Fig. 1), for experimental purposes in 1911. The gyroscope was studied carefully for its ability to roll the ship as well as for its stabilizing characteristics. Fig. 2 shows clearly the *Worden* heeled over to port by the gyros. The gyroscope installed on this boat is depicted in Fig. 3. The rapidly revolving wheel is enclosed in a sealed case and the air is entirely exhausted in order to remove all possible friction that the wheel may produce when it is revolving. It is turned by an electric motor located on the left side of the gyro, as depicted, and the transmission between the wheel and motor is frictional.

The gyroscope is controlled by an advance timing gear and is governed by a small auxiliary gyro (Fig. 4) which, when acted upon by the rolling of the ship, closes the proper electrical contacts. As soon as the ship rolls a fraction of a degree one way or the other, this instrument directs the precession of the main gyro which stabilizes the ship. Unless the main gyro precesses it gives no stabilizing stresses to the ship, so that by breaking and making the circuit between the control gyro and the precession motor, the ship is either free to roll or is held stable.

The operation of the whole apparatus is practically silent, except for the slight humming which is a characteristic of all high speed motors. The connecting gear and control necessarily work at such low speed as to make very little disturbance.

As a commercial device, the stabilizer has considerable value. The owner of a yacht on which a stabilizer is employed does not need to think of seasickness, and knows, therefore, that his guests will be comfortable at all times. He is independent of weather conditions, and can negotiate trips in rough seas, which he would otherwise postpone or avoid.

For passenger and merchant ships which are obliged to sail regardless of weather conditions, and which are likely to encounter heavy storms on long voyages, the stabilizer is of most vital importance. Many await with keen anticipation the day not far distant, when the largest ocean liners will be stabilized, and those affected by the constant rolling of the ship will be able to travel with ease and comfort.

The advantages which the stabilizer will bring to this type of ship are: Saving in power and consequent economy in fuel owing to the ability to maintain the shortest course between two points in bad weather, since the ship will be in no danger from excessive rolling even when steaming in a trough of the sea. The vessel can save a considerable amount of fuel by the resultant elimination of rolling when under way, and also by elimination of the stresses in the structure of the ship and of severe strains in the engines and auxiliaries of the ship, that are caused by the pitching about of the vessel. Deterioration of the cargo caused by the constant rolling is prevented. This would be particularly applicable to ships carrying live stock. It would also increase the seaworthiness of the ship by doing away with the shipping of seas.

One of the greatest advantages of the

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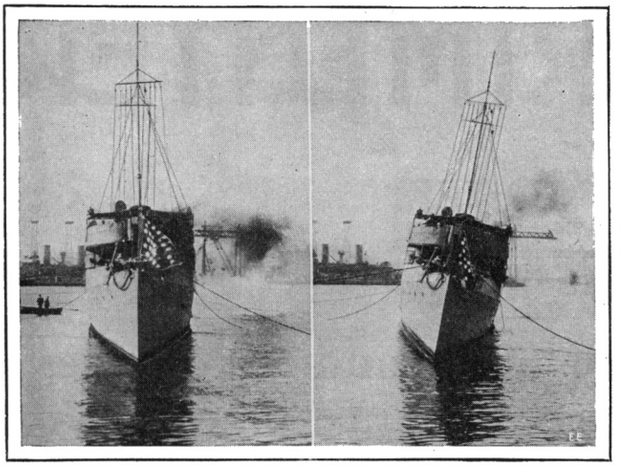
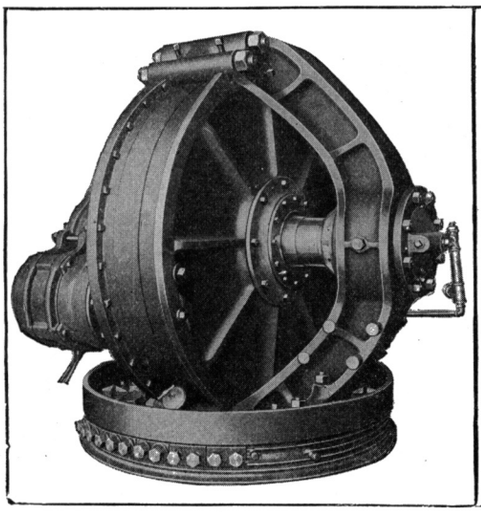
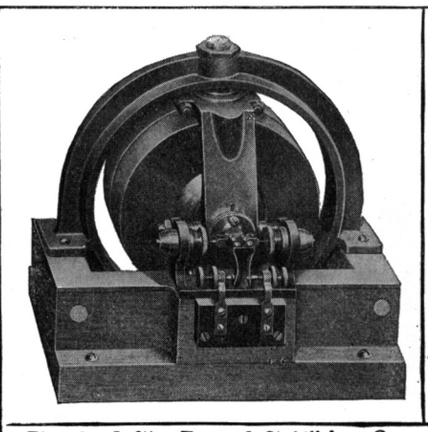


Fig. 1 (Left): Normal Position of U. S. S. Worden. Fig. 2 (Right): Heeled Over by Action of Gyroscope.





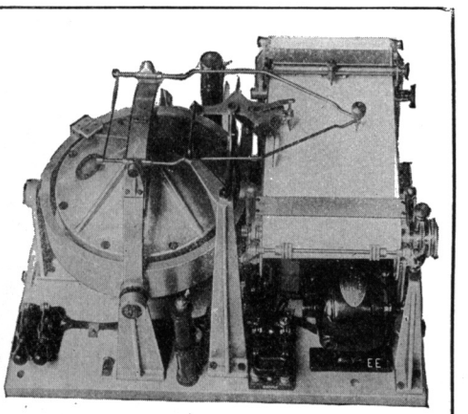


Fig. 3 (Left): Type of Stabilizing Gyroscope Installed on U. S. S. Worden. Fig. 4 (Centre): Small Auxiliary Gyro Used to Control Larger One Seen at Left. Fig. 5 (Right): Latest Type of Gyroscopic Pitch Period and Amplitude Recorder. Produces Graphic Chart Accurately Timed.

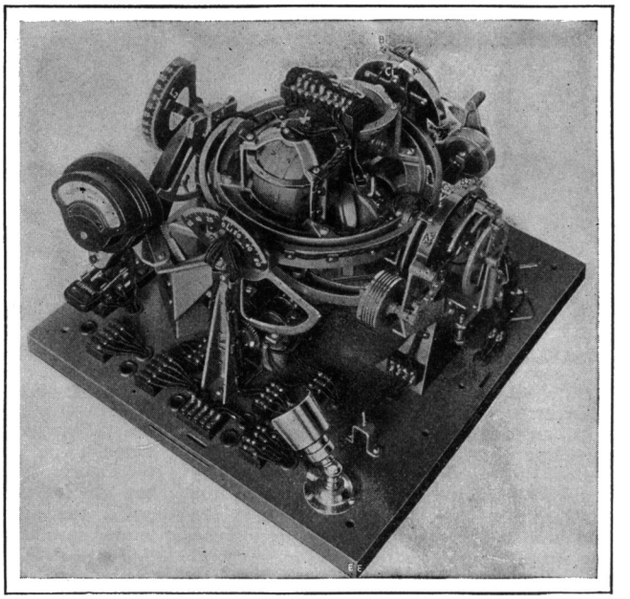
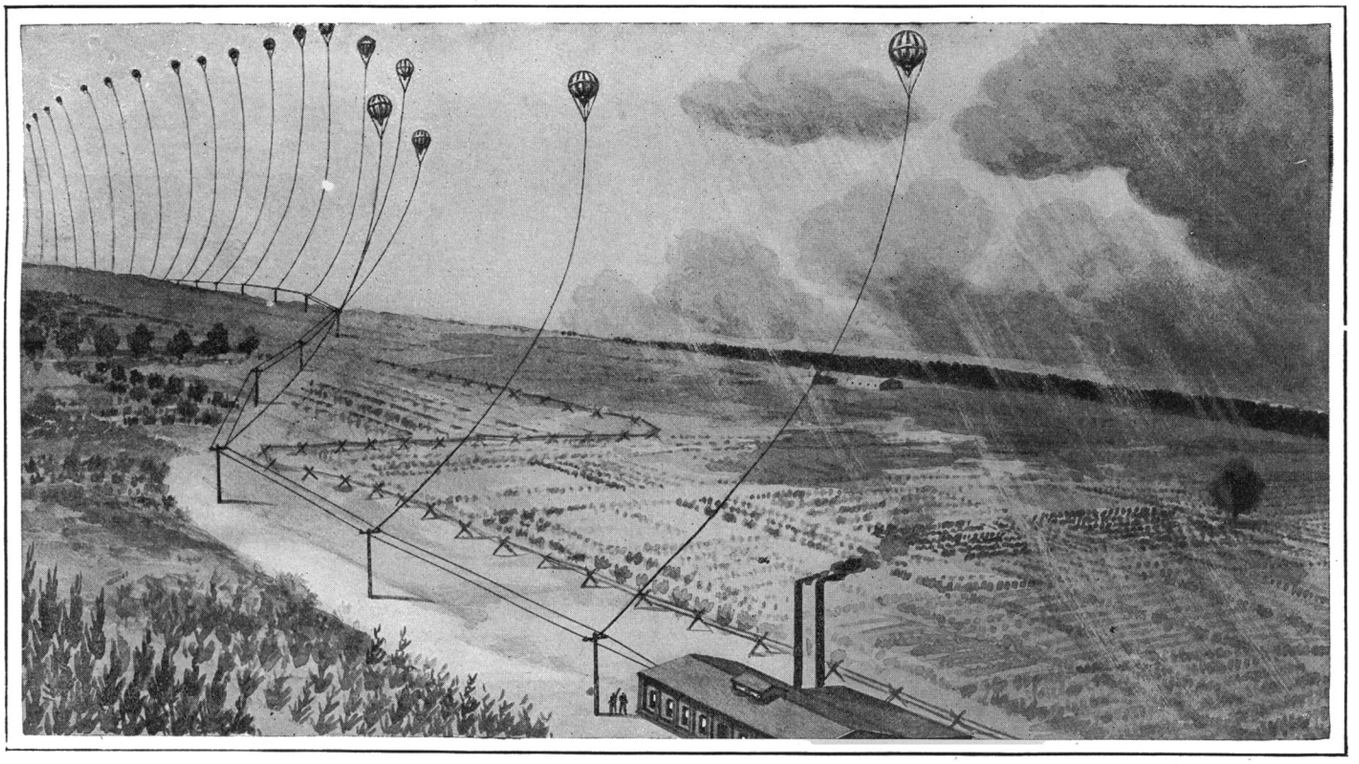


Fig. 6. Automatic Gyroscopic Stabilizing Set for Aeroplanes.

Can Electricity Produce Rain?

RAIN is the much desired commodity called for practically the year round by farmers and others in all parts of the world. In the majority of locations there is usually a sufficient supply of rain produced by nature, but in other less favored spots there is often a severe drought or an entire absence of rain when it is wanted very badly. To solve this riddle there have been many inventions and devices proposed with which to hasten the production of rain or to cause rainfall during the period of such drought.

One of the latest reports has it that extensive experiments are to be tried in Australia by Mr. J. G. Balsillie, who has been conducting research work along this line over a period of four years and has proposed the scheme of sending a captive balloon or a series of balloons up to a height of six or seven thousand feet above the earth. A metallic conductor is to carry a high tension electrical current up to the



One of the Latest Projects is That Intended to Produce Rain by Suspending Electrically Charged Balloons Several Thousand Feet Above the Earth.

balloons, which are supposedly to be covered with a metal foil or a similar conductor, and in this way electricity is to be discharged into the atmosphere. It is thought that a number of these electric *charging* stations erected in the path of the prevailing winds would draw all the moisture from the clouds carried by them down to the earth.

Contrary to general opinion on this matter, it is conceded by a number of eminent writers and authorities on the subject, including a New York City scientist, Dr. Henryk Arctowski, who has had a great deal to do with physical science, especially in its relation to the effects of electricity in the upper atmosphere, that no electrical device, so far as known, can ever possibly hope to produce rain or cause rain, unless the atmosphere is well charged with aqueous vapor suitable for the formation of such rain. In other words, the electricity may be discharged from suitable elevated points, so as to hasten the formation of rain, when perhaps it might not condense and fall to the earth in the usual refreshing manner on the farmer's crops at the time desired. This argument, of course, is a broad one and many able scientists and investigators have contended for a long time that artillery battles would invariably bring rain, especially if they are of very long duration. This matter is referred to by an investigator named Edward Powers in *The American Meteorological Journal* (Vol. IX, 1893), in which he mentions as evidence in accord with the theory, that battles bring rain, the statements of five distinguished generals of the American army that such was apparently the case in many instances. However, this theory is no longer accepted now and the reader will probably have a few ideas of his own after perusing the following paragraphs.

A vast amount of excellent scientific research work has been carried on in the matter of rain production (on a laboratory scale) by different chemical and electrical arrangements by Dr. Carl Barus of Brown University. His work is covered in several sumptuous volumes published by the Smithsonian Institution of Washington, D.C., notably Volume 3, Paper No. 1651, 1905.

To begin with, and we may also say that this theory is generally concurred in by the majority of scientific thinkers of today, rain formation is dependent primarily upon *nucleation*. Dr. Barus describes a *nucleus* as a minute dust particle, sufficiently small to float readily in the air, but its magnitude is larger than the order of the molecule as understood by physicists. These *nuclei*, to the extent of many thousands per cubic centimeter, precipitate condensation in an atmosphere "saturated" with water vapor in its immediate vicinity. Most nuclei are ionized when they occur (as by chemical thermal or mechanical means or by the use of high potential current discharges), or they at least carry an electrical charge of significant magnitude.

The high potential discharge of electricity is a very fruitful source of large numbers of nuclei. An electric glow may be present in such a discharge, favorable to the production of nuclei, but there need be no spark present. A metallic surface charged with electricity is thus a good source of nuclei. Moreover, as Dr. Barus has pointed out, wherever you find a sufficiently intense ionization there also one may expect to find active nucleation, and conjointly the condensation of water vapor, which may be in the vicinity of the nuclei so produced; but if *no water vapor* is present there can be *no condensation, or rain.*

In a very elaborate series of tests extending over a long period and conducted at Providence, R.I., this authority has found that at certain seasons there was a decrease in the nucleation over the city (the values found were expressed in the number of nuclei per cubic centimeter of air measured), especially on Sundays, owing to the fact that the large manufacturing plants, with their smoke and heat producing chimneys, were shut down. During cold weather, however, no reduced nucleation was noticeable in the tests that were conducted. As aforementioned, thermal or heat means may be utilized in the production of nuclei.

The following facts regarding the electrical charge existing in falling rain and snow are of interest to all students of the subject and were ascertained from tests carried out by Prof. J. A. McClelland and J. J. Nolan, at the University College, Dublin, Ireland. A special instrument was devised in combination with a sensitive electroscope, whereby the polarity of the electric charge could be verified with small measured quantities of rain. Of all the rain tested, including fine and large drops, 88.2% was found to be positively electri-

(*Continued on page 57*)

Modern Surgery and X-Ray Work in the War

By S. Gernsback

THE value of X-Ray photographs at the front does not need to be pointed out. There is no base hospital without a complete outfit of Roentgen apparatus, and the work accomplished by the surgeons is truly gigantic, as every soldier who is wounded by a bullet, fragment of a bomb or shrapnel, etc., is transferred to the nearest hospital and X-rayed.

The operation of taking X-Rays of the wounded must be executed quickly and accurately, therefore special installations are provided. The patient is lifted to a couch consisting of a frame over which a canvas is stretched, while underneath the couch the X-Ray bulb is located.

Before the operator takes the X-Ray skiagraph upon the plate, he locates the exact position of the bullet by means of a fluoroscope. After this is done he takes the X-Ray photograph upon a plate which is only exposed to half its size. Now the couch with the patient is slid along its rails for exactly two and one-half inches and the other half of the plate is exposed and a second picture is taken. The operator obtains in this manner a stereoscopic photograph. It has been found that these stereoscopic pictures are of great aid to the surgeon, as he is enabled by them to *actually see into* his patient, so that he can determine exactly before the surgical operation the location of the fractures and the direction of the bullet. Furthermore, as the two photographs have been taken on the same plate, the patient only being displaced, and the source of the X-Ray not having been moved, it is evident that the shadow of the bullet has been displaced. Now this displacement of the shadow can be exactly measured, and through this measure the depth to which the bullet lies in the body is accurately determined, by means of a special slide-measurer invented recently.

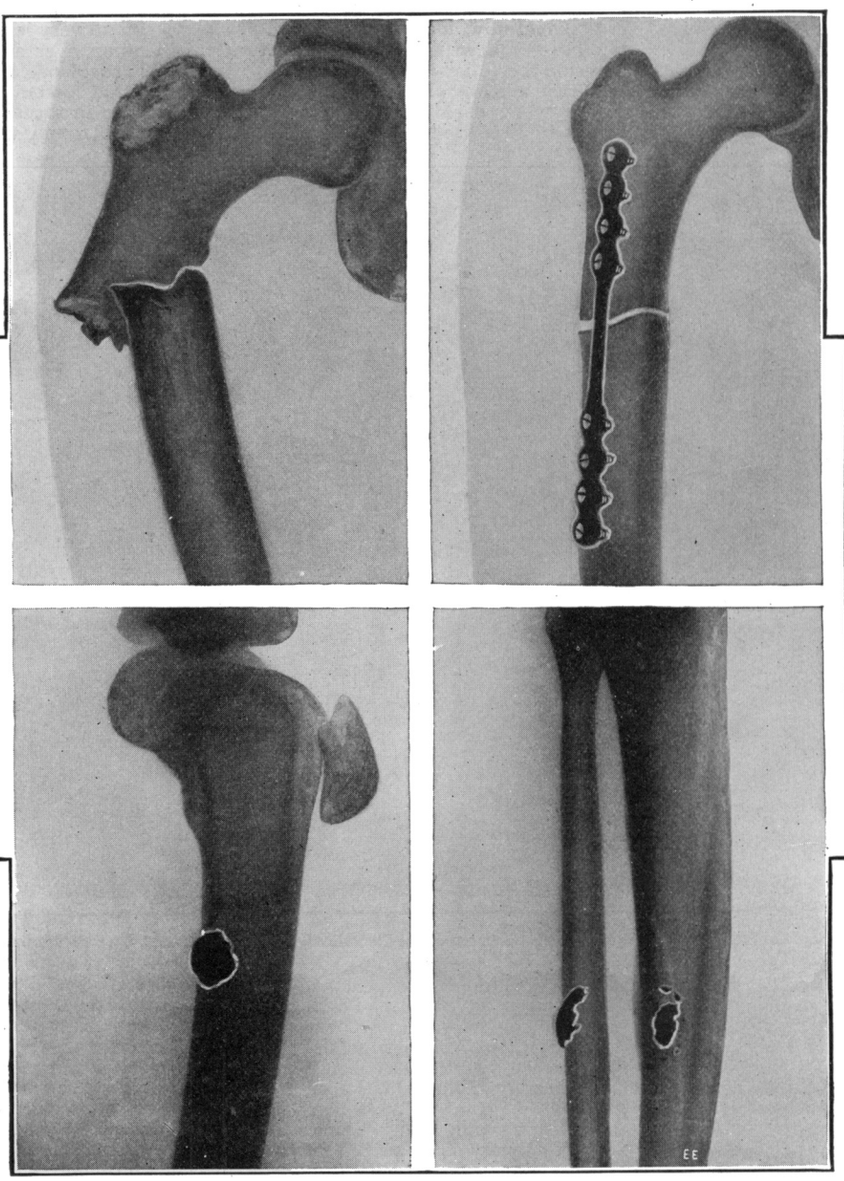
The accompanying illustrations show the fracture of a leg (at the upper left) before the operation, and (at the upper right) after the operation. The unusual point is that the fracture is held together by an ordinary steel brace fastened by means of regular iron screws. The next illustrations (extreme left and right) show a disjointed elbow, held together with three common eight penny nails (these will be removed after the bone has knitted properly). The lower left skiagraph shows a bullet imbedded in the bone and the one to the right shows shrapnel fragments imbedded in the bone, without causing a fracture although the bone was slightly splintered.

Very inexpensive X-Ray outfits can be bought for experimental purposes. It is an easy matter to make skiagraphs similar to these shown, and to help those who are interested in this subject some simple directions are given.

The most important part of taking the photographs is the regulation of the distance between the plate and the tube. The correct distance is a compromise between two conflicting advantages. When the space is increased, a longer exposure is necessary, but the skiagraph is less distorted. Since the rays proceed in straight, radial lines from a single point, it is easy to see why an unnatural picture results from bringing the bulb too near the plate. In photographing the hand, the distance should be at least 6 inches, but preferably 10 inches to 12 inches, and 10 inches is the minimum for the leg. Ten inches is a satisfactory distance for simple work.

To make a trial exposure, put the plate in the holder on the table directly under the bulb. Place the hand on the plate holder and turn on the current. At the end of half a minute cover about two inches of the hand with a flat plate of lead. In thirty seconds more move the plate another two inches. When the plate is developed, it will be easy to determine the proper exposure.

For the comparatively small cost of the apparatus extremely interesting work can be done and almost as satisfactory pictures can be made as with the army sets.



At Right: Fractured Thighbone Before Being Screwed Together (see adjoiningview)

Below: Fracture of Joint Before Surgical Treatment

At Left: Broken Thighbone Screwed Together with Metal Brace

Below: Same Fracture As at Extreme Left "Nailed" Together

At Right: Skiagraph of a Bullet Imbedded in Bone Without Fracturing It.

Skiagraph at Left Shows Splintered Bone Due to Shrapnel Bullet.

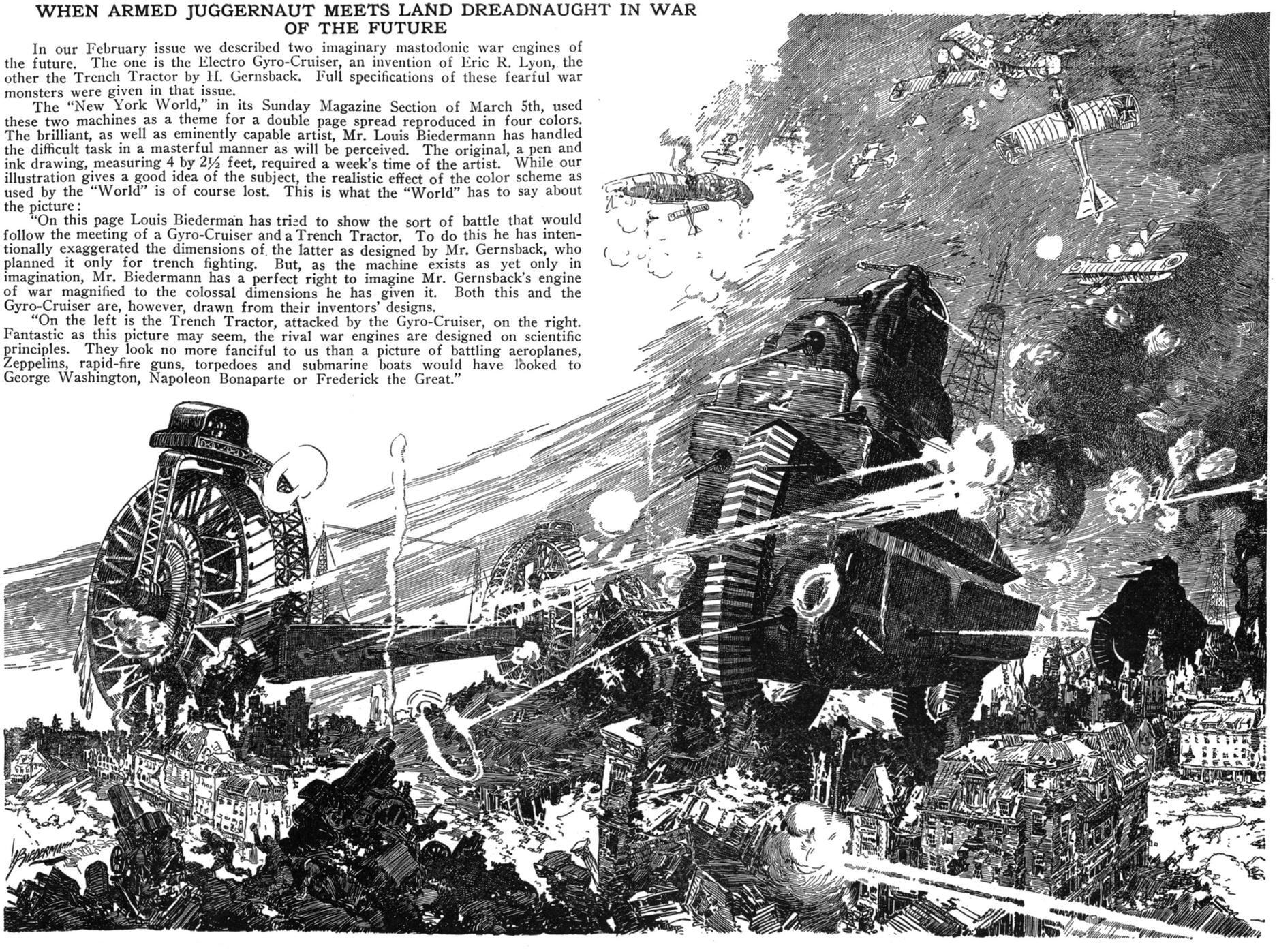
WHEN ARMED JUGGERNAUT MEETS LAND DREADNAUGHT IN WAR OF THE FUTURE

In our February issue we described two imaginary mastodonic war engines of the future. The one is the Electro Gyro-Cruiser, an invention of Eric R. Lyon, the other the Trench Tractor by H. Gernsback. Full specifications of these fearful war monsters were given in that issue.

The "New York World," in its Sunday Magazine Section of March 5th, used these two machines as a theme for a double page spread reproduced in four colors. The brilliant, as well as eminently capable artist, Mr. Louis Biedermann has handled the difficult task in a masterful manner as will be perceived. The original, a pen and ink drawing, measuring 4 by 2½ feet, required a week's time of the artist. While our illustration gives a good idea of the subject, the realistic effect of the color scheme as used by the "World" is of course lost. This is what the "World" has to say about the picture:

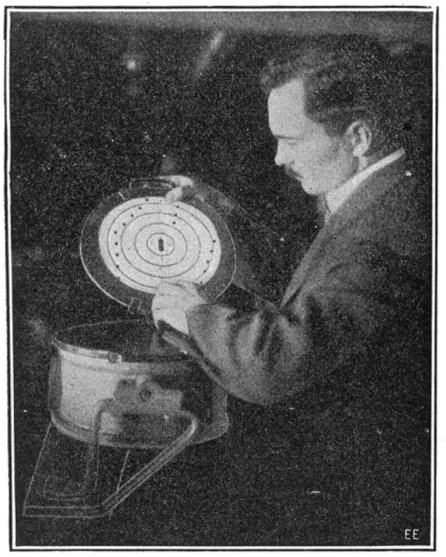
"On this page Louis Biederman has tried to show the sort of battle that would follow the meeting of a Gyro-Cruiser and a Trench Tractor. To do this he has intentionally exaggerated the dimensions of the latter as designed by Mr. Gernsback, who planned it only for trench fighting. But, as the machine exists as yet only in imagination, Mr. Biedermann has a perfect right to imagine Mr. Gernsback's engine of war magnified to the colossal dimensions he has given it. Both this and the Gyro-Cruiser are, however, drawn from their inventors' designs.

"On the left is the Trench Tractor, attacked by the Gyro-Cruiser, on the right. Fantastic as this picture may seem, the rival war engines are designed on scientific principles. They look no more fanciful to us than a picture of battling aeroplanes, Zeppelins, rapid-fire guns, torpedoes and submarine boats would have looked to George Washington, Napoleon Bonaparte or Frederick the Great."



Locating Vessels at Sea by Radio and Sound Waves

AS all scientists know, there is a marked difference between the velocity of wireless and sound waves as transmitted through the ether and the air respectively. As a matter of fact, the radio waves are propagated through the ether at a speed of 186,000 miles per second, while



Mr. Otto Fricke, Inventor of the Radio Fog Compass.

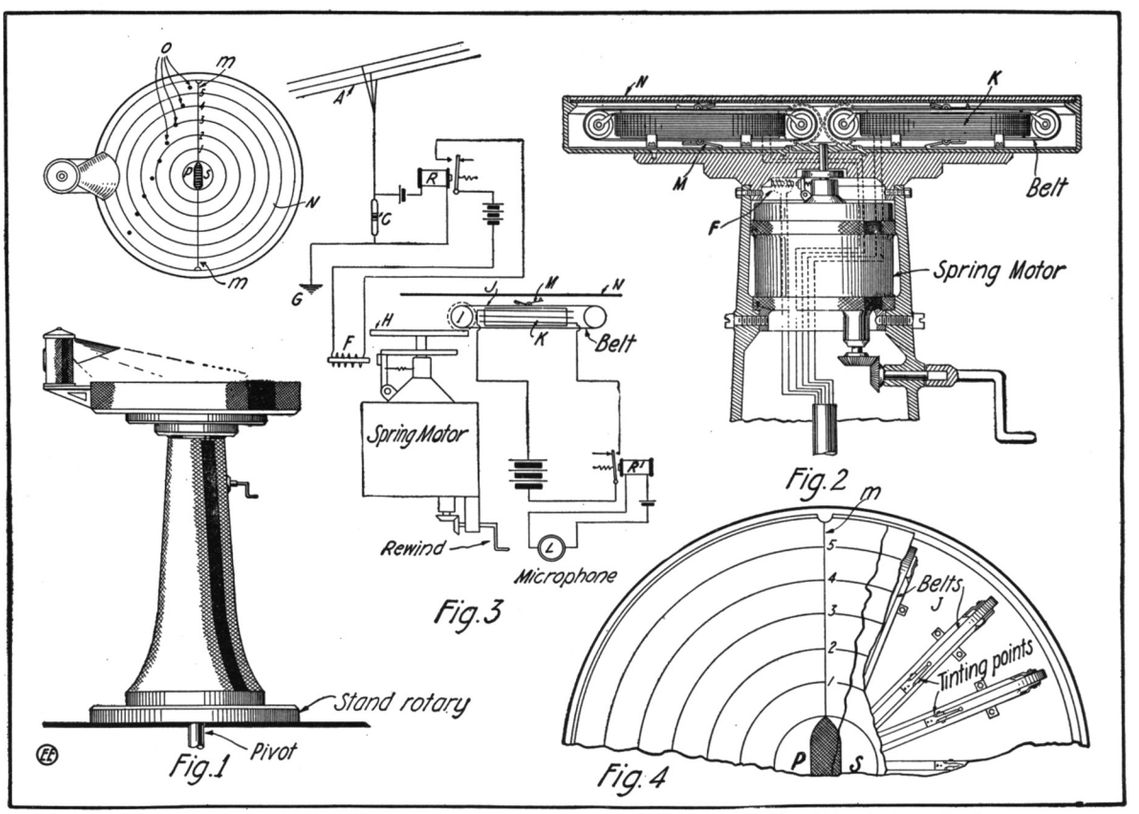
sound waves travel at considerably lower velocity or approximately 1,125 feet per second in ordinary still air. With these two important facts in mind, it has remained for an ingenious inventor, Mr. Otto Fricke, of New York City, to perfect a new form of course-plotting instrument which, when installed on a ship, will enable the navigation officer in charge to ascertain directly how far away and at what angle another ship is located, even though it be enshrouded by fog. The apparatus works automatically and is certainly one of the most remarkable inventions ever brought forth toward the end of safeguarding the great ships that sail the high seas, and moreover it is not limited in its adptations to large bodies of water, but may be used also in lakes, harbors, rivers, etc.

Given the problem that we are to locate a ship situated several miles from a given point as regards its exact distance from this point, and also the geographical direction in which it lies from this same point, the inventor had to set about and develop an apparatus which would solve this scientific conundrum. Owing to the relatively small distance over which this apparatus is supposed to work, when adopted by marine agencies, the well-known but freaky "vacuum space" effects occurring in fog banks and the like and which cause a great difference in the propagation of sound waves through the air, may be ignored.

Mr. Fricke and his remarkable course-plotting instrument are depicted in the accompanying illustration. The diagrammatic views will aid in the explanation of this most wonderful electro-mechanical device.

At Fig. 1 there is shown the general appearance of this instrument. As will be noted this resembles very much the usual compass installed on board ship, as it rests on a vertical pedestal, which also carries a shaded lamp for night readings. In the upper compartment of the apparatus is located a sufficiently strong spring motor with suitable winding handle extending from the side of the pedestal. This motor has its power transmission clutch controlled by a small electro-magnet, F, as indicated in Fig. 2. This magnet is connected up with a wireless circuit (see Figs. 2 and 3), comprising a relay R, coherer C, antenna A and ground G. When a wireless impulse or wave is sent out by the distant "fog hidden" vessel, it impinges upon this antenna and practically instantaneously actuates the electro-magnet F, which then releases the spring motor, aforementioned. The vertical shaft in line with same then rotates and as it carries a worm wheel H, it causes the gear wheels I (a number of which are placed radially about the case as shown in Fig. 4) to rotate. When these gears rotate they carry along, over suitable drums, small belts J (see Fig. 4). Attached to the top and bottom of each of these belts are what is termed "tinting points." As observed from Fig. 3, these are pivotly supported and on one wing of the tinting point, is secured a small piece of soft iron. Inside of each belt is an electro-magnet which is operated or controlled by a relay R^1. This relay is normally open, but if a sound signal, such as from a siren or whistle, strikes the sensitive microphone L the relay will be closed, and likewise the electro-magnet K will be energized, thus attracting the iron armature of the traveling tinting point M. At this juncture the marker is impelled upward, owing to the armature being attracted downward by electro-magnet K, and it will leave a mark or spot on a translucent thin paper disk or dial mounted in the top of the apparatus case (see Figs. 1 and 3).

To recapitulate, it may be said that upon the arrival of a wireless signal from the distant vessel, the spring motor clutch is released, as before described, and all the radial belts start moving outward from the center, carrying with them their tinting points. Ordinarily these points do not leave any mark or record on the translucent paper dial. A few seconds after the receipt of the radio signal, the sound signal arrives, thus actuating in turn certain microphones located about the decks of the ship; it being understood that several of these microphones are to be placed symmetrically both fore and aft and amidships on the vessel, so as to pick up sounds from any direction. These microphones are moreover protected by suitable housings or funnels so that only sounds from a very limited radius will affect any specific instrument. Supposing that a wireless signal has started the apparatus and the belts are all moving slowly outward toward the periphery of the upper drum. When the sound signal comes into effect several seconds later, it causes the relay R^1 to close and in this way to energize the electro-magnet K within the moving belt. This particular magnet will, of course, be connected to a certain microphone located on

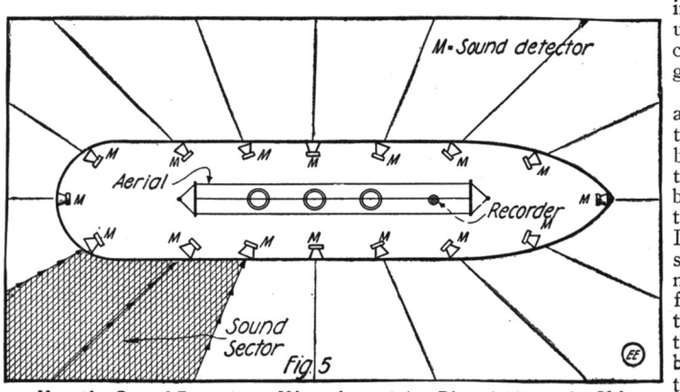


Details of Remarkable Radio Fog Compass Which Charts Location of Hidden Ships Automatically.

a certain part of the ship *geographically* speaking, i.e. facing North, East, South or West, or to intermediate points of the compass. At this stage the electro-magnet K, as stated previously, attracts the iron armature on the tinting pencil M, leaving an identification mark or spot on the dial.

A series of such identification marks corresponding to a successive set of signals as sent out by the ship are perceived at 0 in Fig. 1. Hence it is clear how the record would finally appear to the navigator of the vessel, whose location is indicated at PS (Port and Starboard) in the center of the dial. The line MM indicates the course of the vessel seeking the information, while each radial line extending outwards on the dial represents a distance of one mile. The instrument may, of course, be designed for various distances and is not limited to the exact layout here described.

The arrangement of the sound detectors or microphones about the decks of the vessel are indicated at Fig. 5 and also the relative relation of an incoming sound wave. In case this sound wave sector, so to speak, would affect three microphones for example; then three positions of the distant ship would be registered on the apparatus and the correct range would be the "mean" of the three values registered. After each wireless impulse and sound signal have duly recorded their effects on the dial, which is normally one spot or point on same, all of the traveling belts stop; that is, they are then ready for the next radio impulse to release the clock work for the second registration. The number of points thus recorded by the tinting pencils on the dial will conjointly correspond to the number of radio and sound signals sent out by the vessel giving the information desired. It being presumed, of course, in all this discussion, that if such an apparatus as this is adopted for marine purposes, that some prearranged working arrangement or schedule will be thoroughly understood and observed by the officers in charge of the various ships availing themselves of this latest advance in science. Where the course-plotting compass is to be used in harbors or other bodies of water, in which a great number of vessels are congested, its functions may be properly performed if all the vessels so equipped will exercise care to send out their signals alternately, in much the same manner as ships under similar conditions now exchange ordinary wireless telegraphic signals or messages.



How the Sound Receptors (Microphones) Are Placed About the Ship

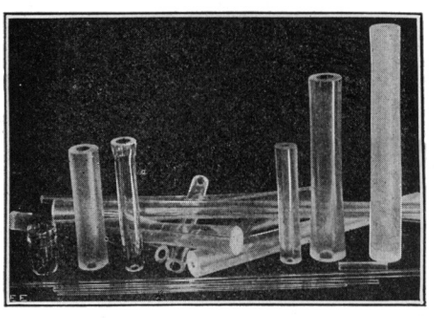
Not only will this device, if adopted, prove of great benefit to the navigators of vessels at sea, but it can also be used to detect the direction and distance of icebergs or rocky promontories from the vessel sailing in such regions. In this event the vessel's siren is sounded when the spring motor is manually released. In view of the fact that the sound wave has to travel to the reflecting surface of the distant berg or rock and then back again, before it can actuate the microphones, etc., the spring motor of the device would be arranged to turn at half its normal speed. Apparently it would be an easy matter in this way to ascertain the approximate distance and direction of such a menace to the safe passage of ships. So far, however, the device has not had an opportunity to demonstrate its practical value.

BORO-PORCELAIN—A NEW INSULATOR.

What is known as Boro-porcelain has been developed and brought out for all kinds of insulation requirements for both high and low potential by a progressive specialist in this line. Boro-porcelain insulator tubes, etc., are shown in the illustration herewith. They possess a number of very valuable characteristics and properties for this class of work.

It is claimed that it satisfactorily replaces porcelain because of its low expansion coefficient, its resistance to breakage both from thermal and mechanical causes, its high resistance to reagents and its perfect transparency.

The linear coefficient of expansion (25 to 350 degrees C.) is 0.0000032 lower than that of porcelain; about one-third that of lead glass. The new substance is very neat and pleasing in appearance and may be examined throughout for defects, as each insulator is inspected by polarized light to show any internal strains, and after this examination it is not necessary to test them electrically, as a body free from internal strains will give its maximum strength, electrical and mechanical, and this has been proven to run very uniform. It is bruitted that it is most valuable when used in the form of tubing, as it shows very little static leakage. The material is adaptable to high-frequency currents or to any other requirements which incur great changes of temperature, fog, dust, lightning or static flashovers, etc.



Boro-Porcelain—A New Transparent Insulator

LIGHT REDUCES CRIME.

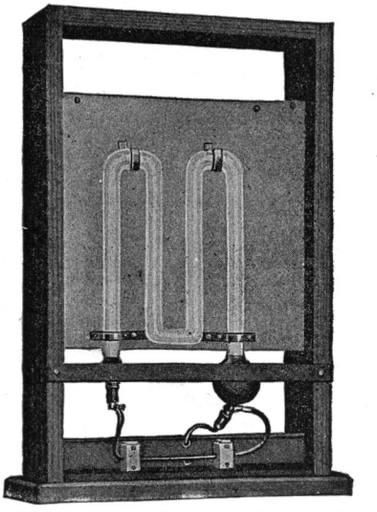
Captain Thomas P. Flahive, of the Kansas City police department, testifying in the Kansas City Supreme Court, stated that street lights were quite as important as policemen in preventing crime.

Captain Flahive is credited with being the best informed person on police matters in the West. He said that the need of policemen is greatest when there are fewest lighted lamps in residence and business districts. Captain Flahive's testimony supports what noted police authorities have said for years—that one lamp was equal to several policemen.

THE PHOTOGRAPHER'S IDEAL ELECTRIC LAMP.

A good deal of experimental work has been conducted in order to obtain a lamp for the photographer which will give perfect results. The ordinary incandescent lamp (both the gas and electric) is unsuitable for taking pictures, as the high lights of the photograph are entirely lost and, furthermore, details are not clearly brought out.

The Cooper-Hewitt mercury vapor lamp has overcome these deficiencies and to-day most all photographers employ this lamp for the production of light for their work. However, several defects were still to be overcome in conjunction with this mercury arc, and recently a new lamp was made wherein all of these were eliminated. This lamp is illustrated herewith. It consists of a standard form of mercury lamp in the shape of the letter M, although different shaped tubes are made, according to the amount of space to be illuminated. The pool of mercury is held in the lower right-hand end of the tube, as perceived, while the other terminal is placed on the other end of the tube as usual. Behind the tube a "light" transformer is placed, which is nothing more nor less than a red reflector. This reflector is flat, as seen, and is covered with certain chemicals which transform the well-known bluish-green light developed by the ordinary mercury vapor lamp to a *whitish light,* which is the most desired in rapid photographic work.



New Mercury Vapor Lamp for Photographers

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain The Electrical Experimenter, we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same despatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

One of the Most Remarkable Electric Apparatus Ever Built

The Thordarson 1,000,000 Volt Transformer

By L. R. PERRY

DURING the closing months of the Panama-Pacific Exposition at San Francisco, recently terminated, there silently and mysteriously arose on a two-acre plot of ground beside the mammoth Machinery Hall, a puzzling structure that immediately filled the mind of the observer with thoughts of the science of aeronautics. Without the slightest bit of public information about it to relieve the suspense and the lips of those in charge sealed there was but one thing to conclude—yes, it must be so; someone was going to build a "Zeppelin" airship! What else could a building so shaped be used for?

There it stood for weeks, while mysterious work went on within. Then one day a huge carload of oil was backed up to the structure by a freight engine and 225 barrels of high grade mineral seal oil donated by the Union Oil Company were run

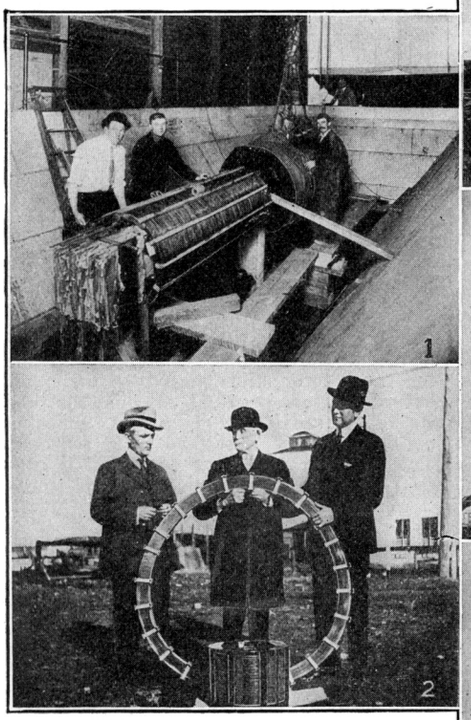
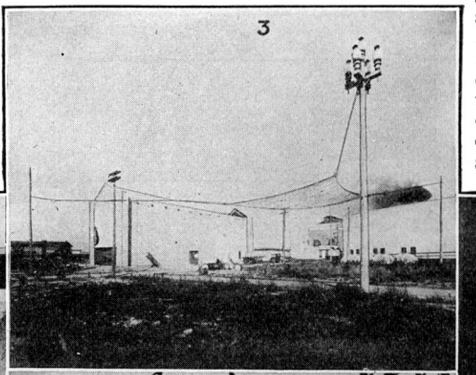


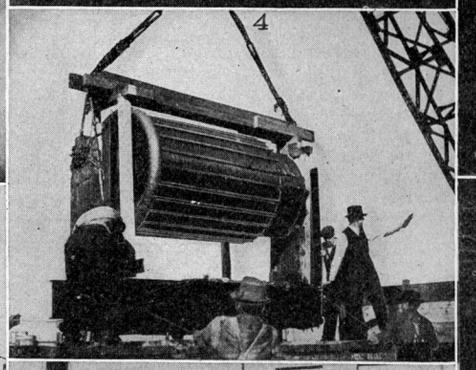
Fig. 1. Lowering Secondary Coil Into Place on 1,000,000 Volt Transformer. Fig. 2. Mr. Thordarson, Designer of Mammoth Transformer and One of the Secondary Sections.

somewhere into the mysterious interior. And shortly after this a large wire net 50 feet square, with 3 feet meshes, was suspended 30 feet above ground from 4 electric light poles, at a point about 100 feet from the building. Then a little later still a second net, somewhat larger than the first and made of hemp rope, was suspended 10 feet beneath the first one. And upon the ground beneath both nets were erected, according to the direction of one A. S. Lindstrom, electrical engineer and Superintendent of Electrical Exhibits in Machinery Hall, peculiar bushy, duster-like bunches of metallic foil on the ends of long wooden sticks.

Soon Mr. Lindstrom, the busy directing engineer, ordered wood frameworks set up about the metallic dusters protruding into the air, and upon these wooden frames numbers of insulators of types commonly seen in use on electric power circuits. And when wires were strung from these dusters down to and along those insulators and left dangling downward with light iron weights attached, the Zeppelin visions faded into thin air. Electricity was the thing!

It transpired that a certain Mr. Thordarson, a transformer specialist and manufacturer, had come out from Chicago with a wonderful new type of electric power transformer. A real and powerful specimen rated at 1,300 H.P., and raising the 2,200 volts (60 cycle alternating current) fed to its primary coil up to 1,000,000 volts (at 60





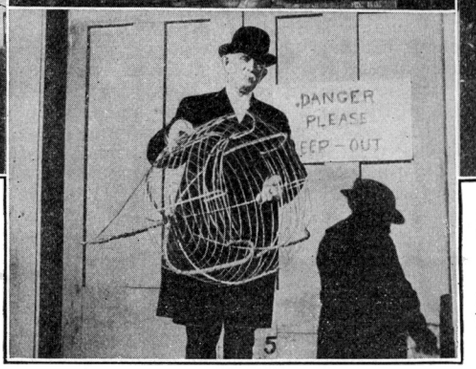


Fig. 3. Transformer House in Distance and Experimental nets. Fig. 4. Unloading the 15 ton Transformer. Fig. 5. Prof. Larkin Holding One of the Electrostatic Strain Distributors Used over all Insulators.

cycles frequency) in its secondary, was soon to be put in operation within the mysterious Zeppelin-hangar-like building adjoining Machinery Hall. And the public, large crowds at a time, was to be allowed to toy and experiment with the wonderful electrostatic conditions and effects it was going to produce where the rope and wire screens were silently hanging. The upper screen of No. 12 galvanized iron wire had, by that time been connected by a single wire to the secondary terminal of the transformer within the building. It was then pointed out also that the top screen and the million volt conductor were supported in a well insulated manner by prepared rope sustainers having a number of odd-appearing wire basket "insulators" placed at all suspension points. And the freeway accorded this dangerous million volt conductor, a thing hitherto unheard of, accounted for the high arching ends of the transformer house. And when it is told that when the wonderful new transformer was later generating only 400,000 volts, the entire building, measuring 100 feet in length by 30 feet in width, and 50 feet high, and constructed without a nail to avoid danger from fire by electrostatic stress, was so charged that any person could step up to the metal door hasps or a few iron bolts six inches long holding the building together on the outside, and draw a continuous quarter-inch spark accompanied by a stinging shock from the same, some idea may be had of what transpired, as the experiments went along, on that two-acre ground-plot next to Machinery Hall.

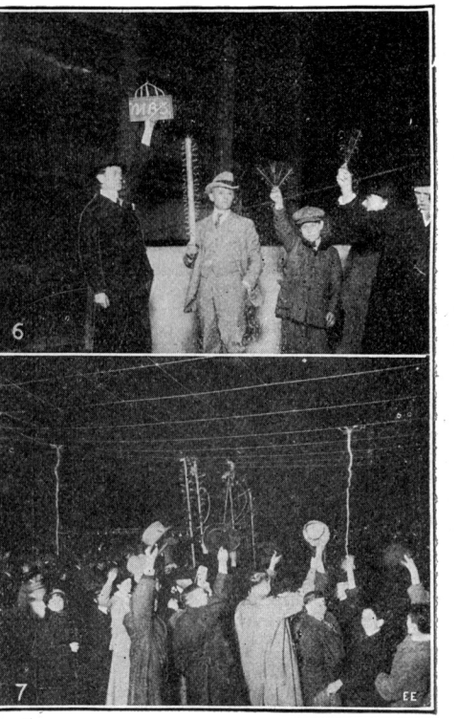


Fig. 6. Spectators Holding Vacuum Tubes Under Charged Rope Net. Fig. 7. Sparks Several Feet Long Could be Drawn from Rope Screen.

The car-load of oil that had been emptied into the building was poured into a concrete, metal-lined tank pyramidal in shape, but open at the top with a rim measuring 16x18 feet. Enough oil was used to completely cover a dark, fascinating, cylindrical object standing in the center and measuring 10 feet in length, 6 feet in height and 4 feet in diameter. This was the transformer and comprised 4 main parts, as follows:

A rectangular magnetic frame or core, formed of a large number of sheets of silicon steel with a sheet of paper interspersed between every five, supported the 3 cylindrical parts.

The primary winding consisted of a paper insulated cylinder of copper wire which measured 67 inches long, 23 inches inside

(*Continued on page 66*)

JOSEPH HENRY.

May, 1916, Marks His 38th Death Anniversary.

Born, Dec. 17, 1797—Died May 13, 1878.

PROFESSOR Joseph Henry was born in Albany, N.Y., December 17, 1797, where much of his early life was passed. He had at first only the advantages

Prof. Joseph Henry, the Famous Electrician.

of a common school education, but later, after two years of work as a watchmaker, he went to the Albany Academy, where he developed a degree of mathematical talent which, in 1826, led to his being selected for the duties of instructor of mathematics in that institution.

While occupied with his duties as a teacher of mathematics in the academy, then in charge of Dr. T. Romeyn Beck, he commenced that line of investigation in electricity which resulted in the important discoveries which made his name famous. He attended the lectures of Dr. Beck on chemistry and assisted him in the preparation of his experiments. At this time he devised and published an improvement on the form of Wollaston's sliding scale of chemical equivalents, in which hydrogen was adopted as the radix, a contrivance which is hardly known even by name to the present generation of chemists. Thus while Professor Henry's original contributions to science were chiefly physical, his first scientific work was in the department of chemistry. His work with Dr. Beck enabled him, after his removal to Princeton, where he became Professor of Natural Philosophy in 1832, to take up the duties of the chemist, Dr. Torry, when that well-known teacher became ill.

It was in the interval between 1828 and 1837 that the most important work of his life was accomplished; that is, in the line of scientific research. His "Contributions to Electricity and Magnetism" were collected in a separate volume in 1839. The analysis of these important researches and a discussion of their priority will be the duty of the academician to whom shall be assigned the preparation of a memoir or eulogy on this distinguished scholar. Some of his most important memoirs and discoveries are: 1. The development for the first time of magnetic power in soft iron sufficient to sustain tons in weight by a comparatively feeble galvanic current. 2. The first application of electro-magnetism as a power to produce continued motion in a machine. 3. An exposition of the method by which electro-magnetism might be employed in transmitting power to a distance and the demonstration of the practicability of an electro-magnetic telegraph, which, without these discoveries, was practically impossible. 4. The discovery of the induction of an electric current in a long wire upon itself, or the means of increasing the intensity by the use of a spiral or coiled conductor. 5. The discovery that the discharge of a Leyden jar consists of a series of oscillations backward and forward until equilibrium is restored. 6. The induction of a current of electricity from lightning at a great distance and proof that the discharge from a thunder cloud also consists of a series of oscillations. He has also contributed to science in meteorology, capillarity, acoustics and other branches of physics.

After a successful scientific career, Professor Joseph Henry died on the thirteenth of May, 1878, at his home in Washington, D.C.

HOW GUNNERS HEAR TELEPHONE MESSAGES ON THE BATTLEFIELD.

The accompanying illustration shows an ingenious English device known as "Ear Defenders" which are to be worn in the ears while on the battlefield during gun-fire. They are so designed that they may be worn inside of gas-protector helmets and the like. They are said to be used on every ship of the British navy and besides are supplied to all land batteries now engaged in the great struggle across the Atlantic. The hollow ear pieces here shown are furnished in a small pocket case and may be instantly removed when desired as they are supported between soft rubber pillars. These tubular nipples have small diaframs within them, which take up the heavy concussive vibrations occasioned by cannon fire and bursting shells, thereby protecting the sensitive diafram of the human ear.

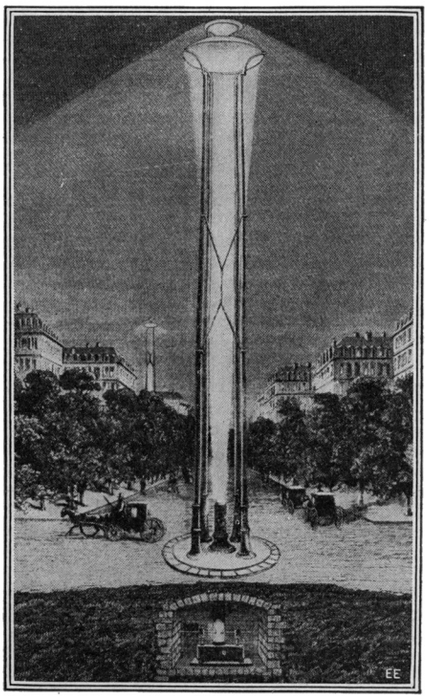
These attachments may be placed in the opening of the ear so as to rest in same securely and without inconvenience to the

Ear Defenders Worn by European Soldiers.

wearer. Moreover regular telephone or radio receivers can be placed against the ear and speech is transmitted perfectly satisfactorily just as if the Ear Defenders were not worn at all. Also ordinary conversation can be heard with them without any trouble during gun-fire, but due to their peculiar design involving the use of the shock absorption diafram, aforementioned, sudden explosions will not directly affect or injure the ear-drum. They were designed by two English engineers, Mr. A. Mallock, F.R.S., and Sir W. G. Armstrong. It is said that they may be worn continuously without any discomfort to the ear, even for hours at a time.

AN EARLY FRENCH ARC LAMP FOR STREET LIGHTING.

Street lighting with arcs was quite common during the latter part of the Nineteenth Century, and while one can imagine the curious designs of arcs that have been



Early Form of Inverted Arc Lamp Used in France.

employed at different periods the remarkable design here shown is indeed radical. In this country the open arc lights were used at an early date and usually hung on some suitable pole supports. On the other hand in some of the foreign countries when electric arcs were first employed for street lighting they were often curiously built. The photograph herewith shown illustrates a unique form of street arc lamp which was used in France in the first days of the art.

This powerful arc lamp, although very unique and picturesque, was not very efficient from the engineer's point of view as the light emitted by the arc is improperly transmitted to its surrounding surface. The two carbon electrodes are supported on a suitable frame which is enclosed in a brick chamber placed below the surface of the ground, as perceived. The terminal conductors are carried underground to the power house. Over the arc is placed a special metallic tube which passes through the upper part of the brick chamber and it is used to transmit the light developed by the arc to the open air. A unique structure is placed around the light tube and supports at its upper extremity a reflector so that the transformed light is equally distributed.

AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.

The Mystery of Gravitation

By H. WINFIELD SECOR

GRAVITY is the one phenomenon which has deeply puzzled scientists of all ages. We have had many volumes written on the subject as to the why and the wherefore of gravity, but the fact still remains, up to the present time, that there has been no successful attempt made to obliterate either its effects or itself. In one of the latest works on the subject entitled *The Universe and the Atom* by Mr. Marion Erwin, C.E., the author says:

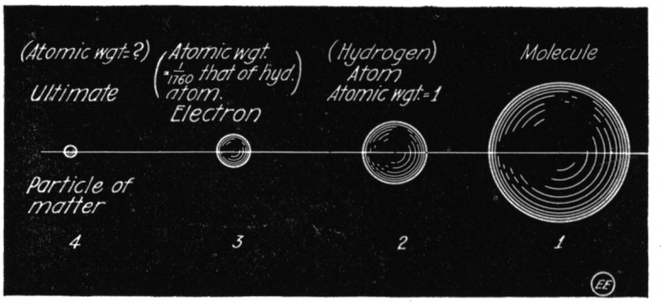
"We have accustomed ourselves to imagining that gravitation acts as if it were a powerful cable reaching out from the Sun to the Earth, and exerting an immense pull upon it, which constrains the Earth to its circular or elliptical orbit. On our present views, however, the radiations of 'force rays' from the Sun, which penetrate each atom of matter of which the Earth is composed, merely exercise a directive influence upon the movements of such atoms. The power which makes the Earth swerve from the tangential path and pursue the circular path is furnished by the *energy in the atoms themselves.* This power would of course be quickly dissipated were it not that the energy consumed in the work of moving the atom is being continuously supplied to it from the ether. The center of the atom may move, but automatically its form, shape and size are preserved by the flows of energy coming to it from the ether.

"We must consider that at all times, through all regions of space, particles of matter must be in process of creation from standard *ether particles* set in revolution by disturbing radiations, passing through from luminous matter already in existence. Gravitation will at once draw these new-born atoms into clusters, the larger clusters will gather up the smaller, and thus meteoric matter will be formed. The sun must be continually gathering up this diffused matter from space by gravitation. This action of gravitation must therefore be an influence continuously operating to change the balance between the amount of energy going into the sun as invisible force rays and the amount of energy radiated off as heat and visible light rays. The result appearing from the evidential facts is a gradual loss of capacity to convert the invisible rays which reach it into heat and light waves. In other words, cooling and condensation by gravity gradually converts a luminous sun into what may be termed a 'dead' or dark sun.

"If matter is being created in nature all the time under certain conditions, it follows that the *reversal* of those conditions and a change in the operation of the forces which tend to maintain automatic continuance of atom revolution, would result in the *destruction of the atom as a material particle,* and reconvert it into the *standard ether particles* of space.

"We must therefore conceive (on this hypothesis) that in the universe, matter is being created by radiations from other matter all the time; that there is going on continuously the gathering up of this new-born matter by gravitation into clusters and suns; that in time these suns go to a kinetic death, and finally the matter of which they are composed is converted again into other substance. Thus we have an endless cycle of births, lives, deaths and resurrections in the material universe."

There seems to be a fact kept well in mind by some of our greatest scientists and also by the lay writers on this topic that *matter* as we know it, and in the form of solid substance, may be either created or destroyed. This does not mean that it is utterly destroyed, but only that it is transformed and converted, say from or into the ultimate particle of matter, or as Mr. Erwin prefers to term it, the *ether particle.* The present scientific endeavor is to bring the atoms of matter into the explanation of the creation and death of worlds and suns as outlined by the brilliant scientist, Herbert Spencer. From the evidence produced it seems that matter begets matter, and moreover that matter is also at all times in the process of creation, and that force and conditions brought it into existence. In this direction there has been recently published a very interesting volume entitled *Ages of Ice and Creation,* and the author of this somewhat radical discourse gives evidence to show (including personal observations) that he has actually *seen life and living organisms created* in ponds of fresh water, which had but a short time previous shown no form or source of life whatsoever. Clearly this shows the work of a Master hand and it seems undoubtedly true that the *ultimate particle of matter* which may have *no weight or material substance* in the way we understand is to-day, may be so mobilized and combined, or caused to combine with each other, that we shall have a *material substance,* and further, under the proper conditions and undoubtedly governed by a greater power than we on earth possess, that there shall arise a substance possessing even life itself and moreover in some cases possessed of a brain so as to care for itself.



Showing the Disintegration of the Molecule into Atoms, Thence into Electrons And Then into—the Ultimate Particles of Matter?

Referring to the illustration herewith, the relation is shown between the molecule, atom, electron and what we have come to know from later day scientists as the ultimate particle of matter or the *ether particle.* This, then, so far as we may judge at present, is a possible line-up of the formation taking place in the creation of substance or material matter. Considering that the ultimate particle of matter or ether particle has no weight by itself until it combines with one or more similar particles, and that after such a combination taking place under the proper conditions of course, due to electrical or other influences, they are believed finally to form the "electron," the lowest present limit in the known forms of matter and its subdivisions. The electrons in turn make up the "atom" which then combine to form the molecule.

The difference in size between these various divisions of matter are vast indeed. The electron is now considered to have an atomic weight of 1/1760 part of the hydrogen atom, taking the atomic weight of the latter as 1. The deduction is reached by Erwin and also in somewhat a different manner by Miller and other philosophers who have written on the subject, that the hydrogen atom is made up of a large number of smaller particles rotating in ring form. It has even been calculated that the hydrogen atom in its primordial form is composed of 1,732 rings, in each of which rings six standard particles are revolving with a tangential velocity equal to the $\sqrt{2}$ around a common center. Moreover it is now considered that while two atoms may attract one another or be attracted by another body, or at least behave as if they were attracted to each other, the simple or ultimate ether particles making up the electron and in turn the atom, *do not manifest any attraction for each other and are not attracted by any other matter.* Some of the best scientific theories we now have on the subject tend to consider the *ultimate particle of matter* to be a *whirl of force* existing in the *ether* and that when properly acted upon by electrical or other radiations sent out by distant stars, particularly the sun, that they are caused to combine with each other and in doing so form a material substance owing to the attraction set up between such ultimate particles. Then also gravitational effects are manifested between such combinations of ultimate particles and the earth, or bodies suitably situated and proportionately near them.

In a recent scientific dissertation by Dr. Saul Dushman in the *General Electric Review* the present accepted theory of atomic structure is concisely and clearly stated. This theory assumes that the atom consists of a positively charged *nucleus* surrounded by a system of *electrons,* which are kept turning by an attractive force from the nucleus, and this in turn is assumed to be the seat of the essential part of the mass of the atom. The experimental evidence has tended to support the hypothesis that the *nuclear charge* of any element corresponds to the position of the element in the series of increasing atomic weights. Chemical properties of the atom depend upon the magnitude of this nuclear charge, but since any given number of electrons may assume different configurations, it is possible for two or more elements to exist having the identical nuclear charge, but simultaneously possessing different atomic weights. In conclusion, the atomic weights thus assume the role of a secondary characteristic and the important property of any element is evidently the nuclear charge; so that by arranging the elements in order of the increasing nuclear charge we ought to obtain a much better approximation to a periodic arrangement of the elements. Thus it seems that there is substantial evidence in favor of some of the latest theories that matter itself is not what it seems, and that it was primarily created by suitable conditions and forces acting upon a very minute particle, which may be an *ether particle* and which moreover possesses no weight or mass. It is also thought that everything in the universe is in constant motion and that the magnetism in a steel magnet is but the evidence of "energy" forever present in a certain form and that every molecule and atom in the iron of the magnet is in motion with respect to themselves; also that certain sta-

tionary conditions giving the iron mass and form as we know it, occur due to primary forces of immense magnitude acting upon them. In this way we see apparently how something is made from nothing and vice versa.

If we could develop proper apparatus it seems possible that we could readily split up not only the molecule and atom as we have already done, but even the electron, the present finest division of matter known to scientists. If this could be accomplished the wonders performed by the far-famed Aladdin's lamp would become a mere commonplace. It would be possible to shoot forth a ray of marvelous power, as shown on the front cover of this issue of *The Electrical Experimenter,* which could set up powerful electric currents in a mighty dreadnought and so act as to disintegrate or split up the electrons forming the steel mass of same and in this way cause the whole structure to lose its gravitational effect. In other words, it would be possible to cause the huge war vessel to be actually raised from the sea as if it were an egg shell and by changing the character of the electrical disturbance or ray set out, it might be possible to cause the ultimate ether particle, thence the electron, then the atom, and finally the molecules which form the mass to recombine and thus to regain its weight and fall back into the sea with a mighty splash, never to float again.

The alchemist sought in vain to convert mercury or lead into gold. John Candee Dean, a well-known scientific writer, states that after considering its atomic structure, mercury might be changed into gold if we could expel from its atoms one alpha particle and a beta particle; or if the metal thallium could be made to expel an alpha particle it would become like atoms of gold. True, we have not done this as yet, but that it is possible from a scientific standpoint seems patent, without a shadow of a doubt, and, moreover, as Mr. Dean points out, it is quite conceivable that it can be done by means of a powerful electric current having millions of volts potential.

Radium and its disintegration into other forms of matter has provided scientific investigators with an excellent basis upon which to build a possible theory or explanation of the structure of not only matter, but the entire universe. When we have come to comprehend and interpret in a proper manner the phenomenon thus set up, Dr. Saul Dushman tends to believe that the concept of an absolutely stable atom must be discarded once for all and in its place we can consider what may be termed a *miniature solar system* corresponding to the central nucleus and the rings of electrons constituting the material atom. The nucleus itself is apparently, as aforementioned, the seat of immense potential forces and in spite of its infinitesimal size, it contains both alpha particles and electrons. Now and then the nucleus of one of the atoms will spontaneously disintegrate and expel an alpha or beta particle. This gives rise to the birth of a new element, but what the cause of this transformation is we do not yet know. If they could be controlled, man could perform wonders undreamed of by any of our present day theorists. If we could but remove two alpha particles from the atom of bismuth, not only would the dream of alchemists be realized, says Dr. Dushman, but man would be in possession of such intensely powerful sources of energy that all our coal mines, waterpowers and explosives would become insignificant by comparison.

Professor William Crookes, the noted English physicist, has calculated that if the total energy in the small quantity of radium which could be placed on the tip of the index finger was obtainable by an instantaneous disintegration of its atoms, it would be sufficient to raise the whole English navy as high as Mount Etna (altitude 10,755 feet).

Thus the good work of our physicists and research scientists goes steadily on. Will they solve, even a thousand, yea ten thousand years from now, the great secret of universal gravitation? We know that the apple falls from the tree to the ground, but exactly why does it do this?

DO you know that the latest scientific theories contemplate that we may, at some not far distant day, be able to nullify gravity and its many effects? In other words, if we can produce an electric current of suffcient voltage, or other suitable agency with which to split up or disintegrate the electron, gravity can be overcome. The electron is considered by many scientists to be made up of a great many minute ether particles, suitably combined due to external applied forces, and moreover, these particles are thought to have no weight and to possess no gravitational manifestations whatever, when isolated by themselves. Gravity, in other words, is created by forces inherent in the atoms themselves and, therefore, may be destroyed or created once we thoroughly understand the underlying principle of matter and its formation.

RESUSCITATION FROM ELECTRICAL SHOCK BY BLOWS ON THE FEET.

Recently one of the foremen of the New York & Queens Electric Light and Power Company, after climbing a pole to string some primary wires, received a shock that caused him to fall to the ground. It is supposed that in adjusting his belt and shifting his position his spur let go of the pole and that to save himself he instinctively reached out and touched the live wires carrying 2,300 volts, so W. P. Strickland writes in the *Electrical World.* When the other linemen reached him, to all outward appearances the man was dead. Immediately, one of the linemen, following instructions, took hold of the ankles of the limp body, lifted it until the whole weight rested on the neck and then let it fall. Then he took a pair of connectors and hammered the soles of the injured man's feet without removing his shoes. Another lineman opened the victim's mouth, pulled forward the swallowed tongue (this always occurs in electric shock) and was about to begin the Schaefer prone method of resuscitation when the man returned to life. He was removed to the hospital and lived although suffering from severe burns.

Some years ago an accident occurred where a man came in contact with 6,600 volts, fell from the pole and was restored to consciousness by this means. Another accident worthy of note happened in New Jersey, when a man came in contact with a wire carrying 2,200 volts. This man was struck violently on the feet, his tongue was pulled out, and he was restored to consciousness before the arrival of the doctor.

WHY YOU SHOULD READ THE JUNE NUMBER OF THE ELECTRICAL EXPERIMENTER

Following are some of the potent reasons why you should read the June number of The Electrical Experimenter if you would keep abreast of the tide in up-to-the-minute events in electricity and wireless. Among the large number of unusually interesting and instructive articles scheduled to appear are the following:

Tesla's Early Work with Radio Controlled Vessels.

A New Scientific Fiction Story. By George Frederic Stratton.

Baron Münchhausen's New Scientific Adventures.

Electricity and the Weather Man.

Mental Telepathy and Disease Germs. By Thomas J. Davis.

The Electric Furnace. By Raymond Francis Yates.

High Speed Radio-Telegraphy. By Charles V. Logwood, Chief Engineer to Dr. Lee de Forest.

Harnessing the Atmosphere's Nitrogen Electrically. By Samuel Cohen.

Experimental Chemistry Course (first installment). By Albert W. Wilsdon.

The Gyroscope—Its Great Utility. (Some unusual applications). By E. J. Christie.

The Mimic Atom—An Experimental Method of Demonstrating atomic Structure. By Eric R. Lyon, A.B.

EDISON SAYS YOU ARE A "MUCKER"!

Are you an electrical Experimenter? Yes? Well, in that case you are a "MUCKER"! A plain, common, ordinary, everyday mucker!! So says one Thomas Alva Edison, and if the "Wiz" says so it must be true. You say you don't like to be called such names? It's a distinction to be a mucker. Edison says he is a mucker himself. Says all scientific experimenters are muckers. So there!

And here's how we found it out. In Washington a few weeks ago Edison stated before the House Committee of Naval Affairs that if necessary he could build submarines at the rate of one a week. During the session the following took place:

Mr. Edison was asked what sum should be appropriated immediately for experimental work.

"It depends on what you want to do," he replied. "I spend about $300,000 a year on experiments, and I am not a fellow to be compared with Uncle Sam."

"Do you think you could get a sufficient number of scientific and technical men to work three shifts in our laboratory?" asked Mr. Roberts.

"Sure," said Mr. Edison. "I can get all the 'muckers' I want."

The committeemen were puzzled.

"A 'mucker' is an experimenter—a scientific experimenter," Mr. Hutchinson explained. "Mr. Edison is a 'mucker' himself. He calls all experimenters 'muckers.'" It was explained that Mr. Edison had been president of a "muckers" club.

So there you are, muckers!

How the Diver Uses Electricity

THE submarine diver of the present day has many scientific devices at his beck and call which render his profession much less hazardous than was the case some years ago. For instance, those who earn their living to-day by peregrinating below the surface of the ocean may have all the advantages of a complete telephone and electric lighting service, no matter how deep they may venture under the water.

At Fig. 1 is shown a modern type of telephone equipment for United States naval divers, the telephonic microphone and receiver not being visible as they are within the helmet. The telephone set observed resting on top of the carrying case is that used by the men attending the diver on the ship or raft. In this way the diver can give explicit directions regarding the air pressure being supplied, etc., thus greatly facilitating the work in every way, as well as safeguarding to a very marked extent the well-being of the diver himself.

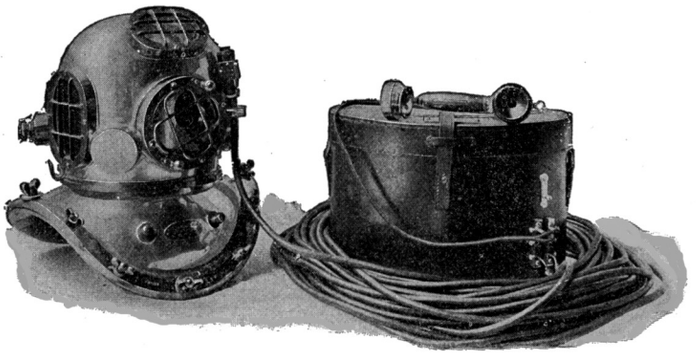


Fig. 1. Telephone Set as Adapted to Divers' Helmets.

In most instances electric current is available where the diver descends, so that he may have an electric light either within or outside of his helmet. However, when no current is available, the outfit shown at Fig. 2 has proved very effective. This comprises a hand-driven electric generator of simple construction and extreme durability. When the crank is turned at a slow speed, a 16 C.P. lamp can be lighted very easily, even through a fairly long conductor. The lamp may be carried in the hand of the diver if so desired. A 125-foot flexible, twin conductor is usually supplied with this lighting outfit, and the dynamo, as well as the lamp, are rated at 15 volts. Electrically driven air compressors with automatic regulators for different air pressures and humidity are available nowadays for the use of submarine divers. There are, however, many refinements possible in this art and invoking the aid of electricity.

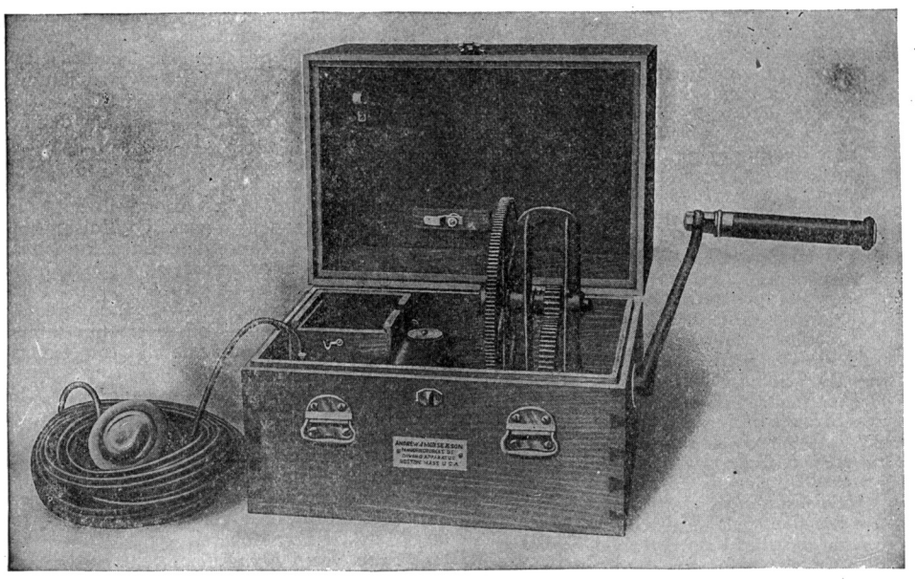
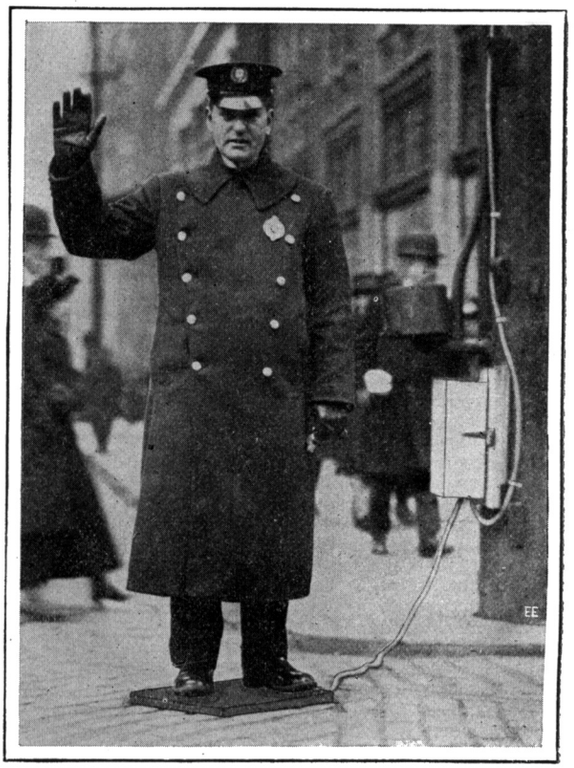


Fig. 2. Turning the Crank Whirls a Small Dynamo, Which Furnishes Current for the Divers' Hand Lamp.

WARMING THE "COP'S" FEET ELECTRICALLY.

Pittsburgh's traffic policemen have gone through a rather severe winter with no frost-bitten toes. The policemen who stand on the windy street corners regulating vehicle traffic have kept their feet warm. The secret is an electric foot pad, distinctly a product of Pittsburgh ingenuity. Early in the winter the city council took up the subject of installing a device that would assure some comfort to the policemen whose duties keep them at street intersections for nine or ten hours every day except Sunday. Drew Johnston of the Duquesne Light Company was called into consultation as an expert and the result was a practical foot-warmer.

The first idea discussed in Pittsburgh council was to have a stationary heater on the curb, but this would have made it necessary for the policeman to leave his post and would be, on cold days, a constant temptation to neglect duty and favor cold feet. Another proposal was that the heater be placed firmly in the paving, but the cost of installation would have been prohibitive for experimental purposes. The final decision brought the warming plate 18½ inches square and 1½ inches thick. It resembles a griddle and is connected with an electric plug and switch on a pole at the curb. The intermediate connection is a flexible armored conduit about 10 feet long. The cornerman, when he leaves his post, or when the weather is not severe, carries his heater to the curb and pulls the plug from the socket.



Courtesy Pittsburgh Industrial Development Commission

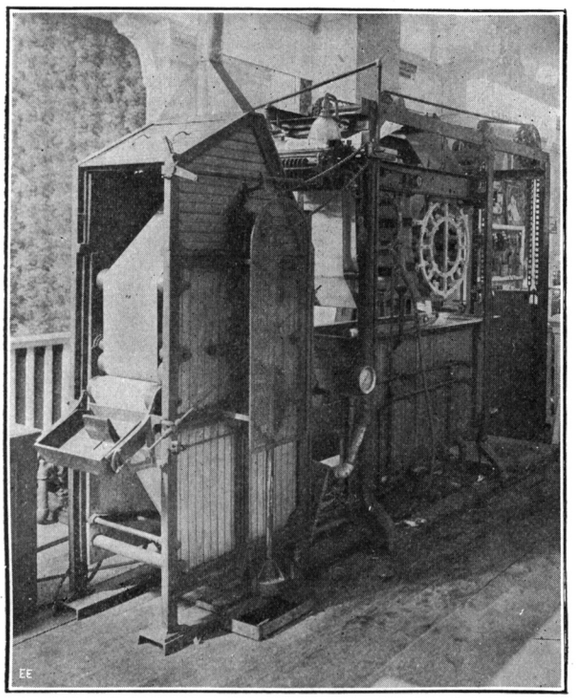
How the Pittsburgh, Pa., "Cops" Kept Their Feet Warm Electrically the Past Winter

Mr. Johnston, when he had completed his plans, took the matter up with the experimental department of the Westinghouse Electric & Manufacturing Company and the heaters were made there.

The switch controlling the heat permits of four temperatures which can be changed to meet the weather demands. At no time does the foot plate develop a temperature that will burn the soles of the shoes. The idea is not so much to warm cold feet as to keep the feet from getting cold or frost-bitten. For all ordinary weather conditions the heater can be operated on less current than is required for two ordinary 40-watt bulbs such as are used in residence illumination. The accompanying photograph shows Policeman C. L. Dye of the Pittsburgh traffic squad at his station, Sixth Avenue and Smithfield Street, where it is said there is more vehicle traffic in a day than at perhaps any other street intersection in the United States.

CLEAN YOUR MONEY BY ELECTRICITY.

It is believed by many persons that all the paper currency returned to the United States Treasury Department is burned up



This Machine Washes Your Dirty Money in a Jiffy.

or macerated, but this is not true, as the majority of them which are received by the department are in a fairly good condition, although very dirty. Of course those which are mutilated are usually burned up. Several years ago, however, every bill which was returned was burned, but as soon as this new washing machine for currency was invented this was done away with, so far as the soiled bills were concerned.

The old type of machine was more of a nuisance than a benefit, for it often destroyed the bills and let others come out half washed. These obstacles were overcome by close and careful experimentation on the part of the Government engineers, so that to-day they have a machine which is marvelously efficient. The machine herewith illustrated enables thousands of bills to be thoroughly washed and cleaned daily without the slightest trouble.

It consists of an endless belt driven by an electric motor. This belt immerses in one place into a tank which contains a washing solution used to dissolve the dirt accumulated on the bill. As the bill goes through the various rollers it is brushed and dried and when it reaches the final roller it is as clean as when it was first made. With this machine Uncle Sam saves thousands of bills, thanks to the engineers who devised this wonderful mechanism.

Photo by courtesy of New York Edison Co.

WEATHER NEWS BY WIRELESS.

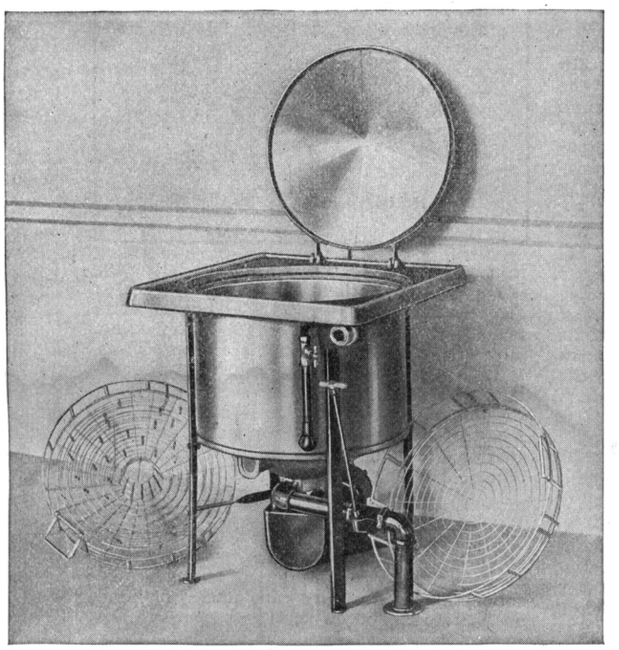
Iowa towns that have wireless telegraph stations may get their weather forecasts by the air route from the big wireless station at Iowa State College. Co-operative arrangements have been made by Dr. G. M. Chappel, of the college staff.

SUNSETS AND SHOWERS MADE BY ELECTRICITY.

The up-to-date theater couldn't exist without making an extensive use of electricity. Theatrical managers were among the first to adopt electricity, and they have been heavy users ever since. A notable installation of various new electrical theater devices has been made in one of the largest playhouses in New York.

The stage is equipped with hundreds of border lights, footlights, projectors and other apparatus. This equipment will produce any effect from a mountain sunrise to a golden sunset, and then show with all the vividness of actual life the burning of a house at night or a distant thunderstorm. A long, narrow glass runway through the auditorium is used in conjunction with the stage. A multiplicity of high-powered incandescent lamps concealed in the runway produce the aurora borealis effects upon the performers. For general lighting of house and signs hundreds of other lights are used.

During the warm season a number of electric motors blow air through a box of ice into the auditorium by means of large electrically driven fans. Dozens of motor-driven fans at vantage points keep up the air circulation. Motors are also used for mechanical features, such as operating hoists in flying ballets and turning circular swings and revolving platforms.



Heavy Service Dishwasher, Occupies Space Only 28 Inches Square.

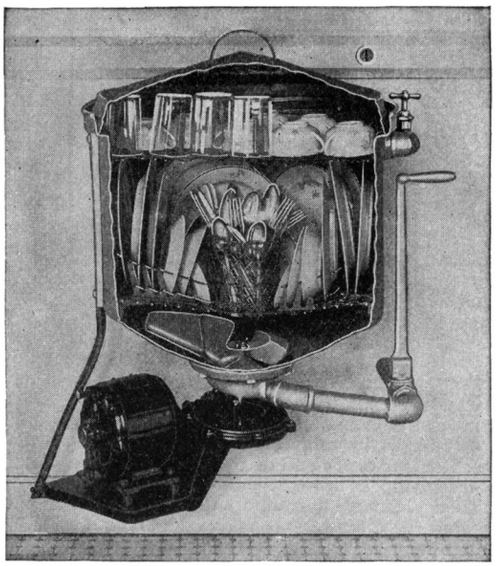
Electricity has been proved to be a most potential factor in keeping the stage alive and is furnishing a range of effects that no other means of light energy could supply.

PARDONS WIRELESS PROMOTER.

President Wilson granted a pardon on Oct. 19 last to Cameron Spear, of New York, former head of the Collins Wireless Telephone Co. Spear was serving a five-year sentence in the Federal prison at Atlanta for criminal conspiracy and using the United States mails to defraud.

ELECTRICAL DISHWASHER SAVES MUCH LABOR.

The illustrations herewith depict two views of a very efficient electrical dishwasher recently placed upon the market which bids fair to remove most of the drudgery and menial labor associated with



Small Model Electrically Operated Dishwasher for Family Requirements.

this task. One illustration shows a sectional view of the device, and, as may be seen, it has considerable capacity for the small size of the tank owing to the dishes, silverware, etc., being packed in the removable wire rack or tray of the apparatus, there being two of these trays placed one above the other. The heavy service type of dishwasher shown in the second illustration is supported by suitable legs and requires a floor space only 28 inches square.

It is a one-tank machine, sturdy but not heavy, and when the trays are removed, as shown, there is nothing in the tank except the dasher resting on the bottom. All the work is performed in this one tank—the scouring, cleansing, rinsing and drying. The right and left ends of the top may be removed so that two or more washers may be grouped together if desired. Four different styles of trays are furnished with the washer, one for flat china, one for cups, bowls and glasses; one for silver and one for milk bottles. The dasher is a rapidly revolving motor-driven blade at the bottom of the tank which throws the water upward with considerable force through the trays, between all of the dishes, silverware and other articles being washed.

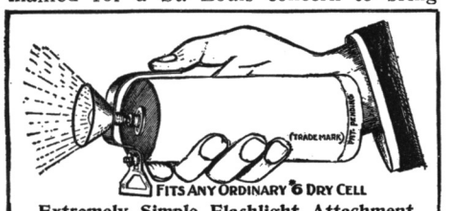
WIRELESS TELEPHONE TEST IS SUCCESSFUL.

Amateur wireless telegraphers "listening in" recently heard talking, whistling and singing on their wireless apparatus, owing to a test conducted by A. F. Van Dyke, instructor of electrical engineering at the Carnegie Institute of Technology.

Latest Electrical Novelties

UNIQUE ELECTRIC LANTERN.

There has been a regular flood of dry cell electric lanterns, so to speak, on the market, and while many have indeed been ingenious and highly efficient, it has remained for a St. Louis concern to bring



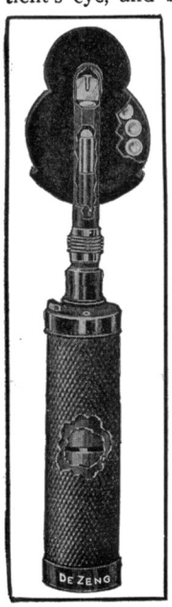
Extremely Simple Flashlight Attachment for Dry Cells.

out one of the cheapest attachments of this kind that we have as yet seen. This device is shown clearly in the illustration and consists simply of a punched metal strip with a projecting lug on one side. This enables the contrivance to be hung up, carried or laid on its side without turning over. The attachment is clamped to the zinc binding post of the dry cell, and by pressing downward on the outer end of the strap, the base of the lamp is brought in contact with the carbon electrode terminal of the cell, thus closing the circuit.

A highly polished reflector is fitted to the attachment, and the whole arrangement will undoubtedly find a wide sale owing to the very low initial cost.

NEW ELECTRIC INSTRUMENT FOR EXAMINING THE EYE.

In the accompanying illustration is perceived one of the latest devices intended as an aid to the eye specialist. It employs a flashlight dry battery in the handle, and mounted on it are the interchangeable metallic stems of the instruments. One of the instruments, known as the electric ophthalmoscope, has a changeable diaphragm or a series of diaphragms, behind which is placed a miniature but powerful electric lamp. In using this instrument the doctor holds the diaphragm close to his eye and looks through the opening. A powerful, concentrated electric light beam is projected into the patient's eye, and by this means of illumination the optometrist is enabled to observe the eye minutely and accurately. Another attachment is known as the electric retinoscope. There are a number of auxiliary attachments supplied at slight extra cost for use with the standard handle, which contains the dry battery.



"ELECTRIC HOBO" WORKS IN CALIFORNIA.

Wanderers have been known to adopt various means of obtaining a livelihood and are known by various types, but a new variety has just been discovered in California.

He is known as the "electric hobo." He is never without a hot meal when he can beg the ingredients with which to cook, and he doesn't have to carry a match with him or worry about kindling a fire.

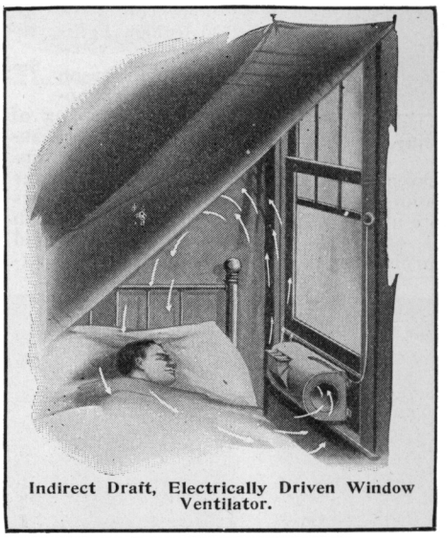
The Northern Electric Railroad Co.'s third rail is his stove, or at least the source of his fire, for he carries with him a patent stove. It consists of a folding iron plate, interlaced with copper wires. When he gets hungry he unfolds it and makes a connection on the third rail, places the food on the stove and, when ready, eats to his heart's content. Jack rabbits, vegetables, coffee and flapjacks can be cooked on the electric grill.

C. B. Harter, a Sutter County rancher, says he saw the "electric hobo" at work cooking his breakfast the other morning. Among other things he located a can of water on the stove, took a rusty razor from one pocket, a cake of soap from another and a piece of mirror out of his coat lining and shaved. Who says the life of a hobo is a hard one?

MOTOR DRIVEN ELECTRICAL WINDOW VENTILATOR.

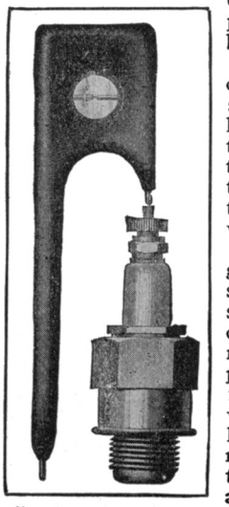
When the wintry winds are blowing about it is not very comfortable to have a window open, even in large buildings or offices, where drafts are not so readily noticed as they are in small quarters; for this reason there has been developed a number of different ventilators of one description or another intended to overcome this objection. The very neat and effective window ventilator here illustrated consists of a cleverly designed metallic chamber, attachable by means of a window board, as perceived, to any standard window opening. It may be placed at the top or the bottom of the window as desired.

It does not produce any direct draft, the air being forced out through a specially devised diffusing orifice and returned to the outer atmosphere again through a suction fan propelled by a small electric motor mounted inside the casing of the ventilator. The motor carries a fan blade of efficient design on either end of the shaft, the second blade pumping the air from the outer atmosphere into the room. The motor is mounted in a cork suspension diaphragm which reduces the noise of vibration and whirr to a minimum. The motor is supplied for either alternating current or direct current circuits and uses but 33 watts per hour, or less than an ordinary lamp. The ventilator is made in three sizes. Thus, it is possible to effect a continuous circulation of fresh air in any desired part of the house. Such a device is highly recommended for consumptive or sick room ventilation, besides being widely adaptable to offices, dwellings and manufacturing plants.


Indirect Draft, Electrically Driven Window Ventilator.

A NEW SPARK PLUG TESTER.

A simple and convenient tester for spark plugs on automobiles, motor boats, motorcycles, etc., is being put out by a Pittsburgh concern.

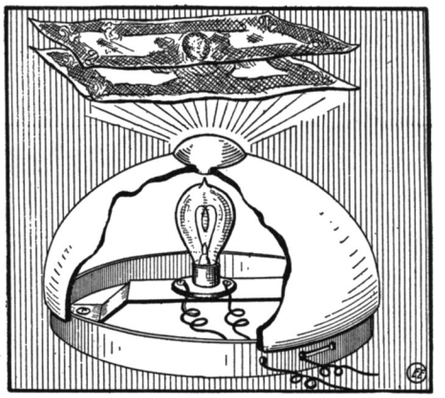


It consists of a crotch containing the spark gap and two legs containing the terminals. One leg is three inches longer than the other, so as to permit of convenient contact.

When the plug is good, the tester shows a regular spark. If it is short-circuited it will show no spark. If the plug porcelain is defective, the tester will show an irregular spark. If the motor has no power, the device will show a clear spark, indicating that the trouble is in the mixture. When there is a knock in the motor, the tester will magnify the knocking noise and thus locate the cylinder in which it occurs. This apparatus is made of hard rubber with rounded corners. It is five inches long and convenient to carry in the pocket.

ELECTRICAL DEVICE INVENTED TO DETECT COUNTERFEIT MONEY.

To facilitate the detection of counterfeit money and also the differentiation of paper currency, as when two bills become stuck together, such as in banks, where a great deal of this work occurs, there has been recently brought out a novel device in the form of a powerful electric lamp and shield for same, as our illustration shows. The top of the shield is fitted with a bull's-eye lens and the light is concentrated and intensified in this way. If two bills are placed against the lens the difference is at once noticeable, as the rays will readily penetrate one bill only. It is claimed that this device is also efficacious in detecting counterfeit bills, owing to the distinct difference noticeable in the paper pulp and fiber structure of same, as compared with genuine bills.

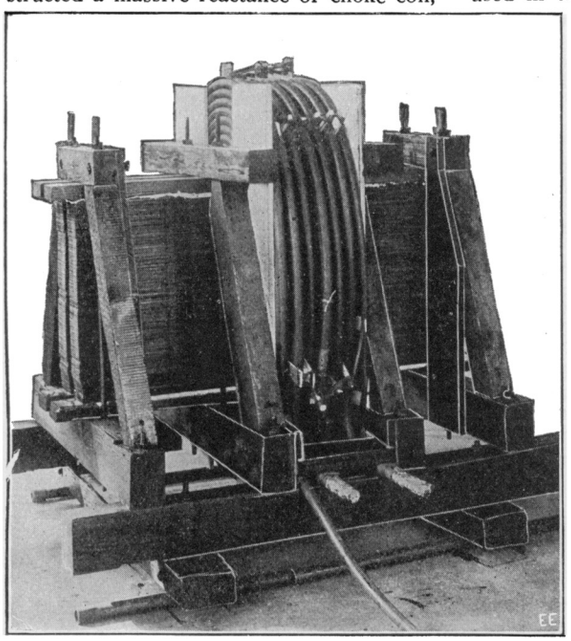

Clever Device for Detecting Counterfeit Money.

POWERFUL RADIO STATION.

One of the world's most powerful wireless stations is being built by the French Government on the island of Tahiti, in the Pacific.

A Massive 1,000 K.W. Choke Coil

For the expedition of some recent extensive cable tests recently conducted at the Walpole sub-station of the Edison Electric Illuminating Co., of Boston, there was constructed a massive reactance or choke coil, which is shown in the accompanying illustration. This coil was rated nominally at 1,000 k.v.a. or 1,000 kw. with unity power factor. It was figured out by Prof. C. A. Adams, of Harvard University, that a reactance of approximately 1.4 ohms should be used in the low-tension circuit to insure a good wave form in the high-tension circuit. Several unsuccessful attempts were made to borrow one or more reactances from the various electrical manufacturers, so it was decided to construct the reactance in the laboratory of the aforementioned company. The iron core was built up of sheet laminations similar to a transformer core and had a cross-sectional area of 140 square inches. About 56 turns of wire were used in the winding around the core.



A 700-Ampere, 1,000-Kilowatt Choke Coil Which Exhibited Many Interesting Characteristics.

The core required about 15,000 iron laminations, which were taken from an old lighting transformer and reassembled. They were built up into two slabs, each 3½ inches thick, 24 inches high and 4 feet long, with a 1½-inch gap between them for ventilation. The weight of the core so formed was about 2,000 pounds. This core was then wound with 500 feet of 500,000 cm. flexible copper cable in pancake coils of 8 turns each, with air ducts left between for ventilation and the dissipation of heat. The coil was insulated for 2,300 volts and designed to carry about 700 amperes.

During the preliminary tests at the laboratory and later at the Walpole sub-station this coil evinced several quite spectacular characteristics. When the direct current of 700 amperes was sent through the winding it caused the iron core to become, of course, a mighty electro-magnet. Under this condition a 20-inch screwdriver with its point sticking to the end of the coil would become tangent to the leakage lines of magnetic flux, although the axis of the screwdriver was stationary in the air at an angle with the floor. When the alternating current was passed through the windings, bolts and even nails from 1 inch to 6 inches *away from the core* became so hot as to slightly char the wooden frame of the reactance. This heating was caused by eddy currents produced in the bolts or nails by the powerful leakage lines of magnetic flux passing through them.

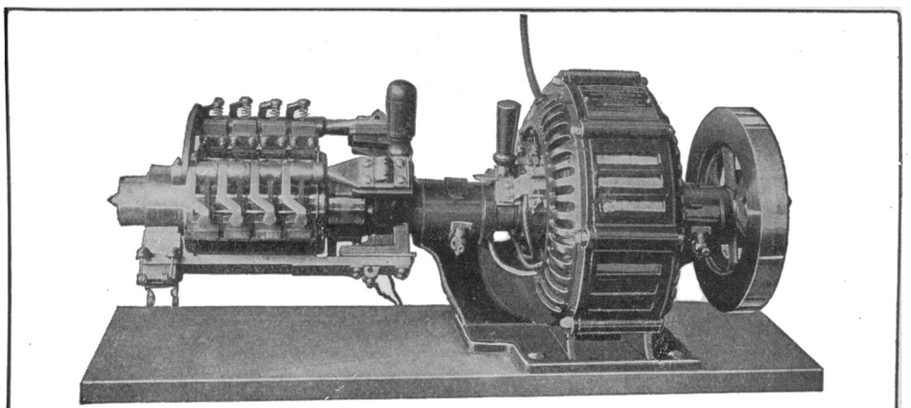
This, we believe, is the largest choke coil ever constructed for practical purposes.

IMPROVED MOTOR-DRIVEN ELECTRIC RECTIFIER.

One of the latest inventions in the electrical line is in the nature of a mechanical rectifier for converting alternating current to direct current for motion picture machines and the like. The illustration shows the apparatus quite clearly. It consists of a self-starting, synchronous alternating current motor, which drives the commutator. This motor is constructed so as to operate in absolute synchronism with the changes in the alternating current. By special design of this particular motor undue hunting or surging is minimized. At 60 cycles, or 7,200 alternations per minute of the alternating current, the motor is running exactly at 1,800 r.p.m., thus driving the four-part commutator in synchronism with the current reversal waves.

One of these rectifiers has been installed in the Academy Theatre, Pittsburgh, Pa., for the past year and half and has given complete satisfaction. It is used for operating a stereopticon. Its capacity is 90 amperes and its electrical losses are claimed to be but 2 per cent.

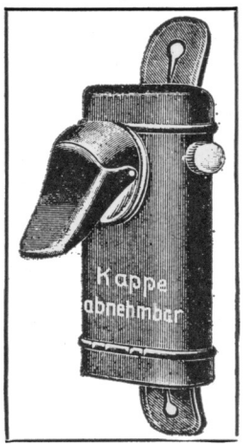
To those electrically inclined the design features of this machine will be fully appreciated, as there has been heretofore practically no device of similar type successfully designed. In such machines that have been brought out there has always been such a great amount of sparking and flashing at the rectifier commutator that they were quickly sent to the scrap heap. This machine is claimed to have a specially designed commutator and brush gear which reduces sparking and deterioration of the apparatus to a minimum. Special features have been incorporated in its make-up, which care for any such occurrences as the motor dropping out of synchronism or step. These ingenious rectifiers are furnished in several sizes and small ones for private garages, etc., are available for charging ignition storage batteries.



Motor Driven Rectifier for Heavy Loads and Capable of Converting Alternating Current into Direct Current.

FLASHLIGHT DESIGNED FOR TRENCH WARFARE.

The Germans have made very extended use of electricity in all of its varied phases and their soldiers now use pocket flashlights by the hundred thousands. A novel design of such a pocket flashlight is herewith illustrated. It is mounted with two leather straps, so that it may be secured to a coat button or held in the hand. It will be noted that this flash lamp is fitted with a forward projecting shield over the lens so as to throw all the light downward. This feature is self-explanatory, as, of course, it is not permissible to expose one's position. For signaling, the spring-actuated shield is depressed by one finger, and in this way long and short flashes of light, corresponding to the telegraphic code signals, may be rapidly and accurately transmitted for a considerable distance. A great deal of ingenuity is evidenced in some of these designs intended for military signals, whereby different colored lenses are used to aid in distinguishing from what division or brigade the signals are being transmitted.



ELECTRICITY PRODUCES STEEL DIRECT FROM ORE.

United States Consul Felix S. S. Johnson, of Kingston, Ont., Canada, has reported on the electric smelter at Belleville, near Kingston, which produces steel of all grades, including tool steel, direct from the ore.

The furnace is charged from the upper floor into a preheater, the charge consisting of iron ore, limestone and charcoal, crushed to pass through a one-inch mesh. The furnace is operated on two-phase current, the transformers being connected by the Scott connection. The electrodes are 3 inches in diameter, threaded so that they can pass down continuously, and are used up entirely, there being practically no loss from short ends.

The plant was in operation for about two months, and demonstrated that steel can be made in this manner directly from ore containing 7.5 per cent. of titanium. A quantity of high-carbon steel was made, the ingots being perfectly sound and free from blow-holes or other defects.

Modern Concepts of Electricity

By Samuel Cohen

"WHAT is electricity and matter?" This simple question has led scientists and physicists to endless suppositions. A large number of theories have been developed from time to time trying to explain what electricity really is and this was done by considering electricity as a weightless substance. Several scientists claimed that an excess of this weightless substance caused a positive charge and a deficiency negative according to the one-fluid theory of Franklin, or assuming two different fluids, one positive and one negative, as in the two-fluid theory. Although these theories were held until about 1900, they are not quite believed to-day.

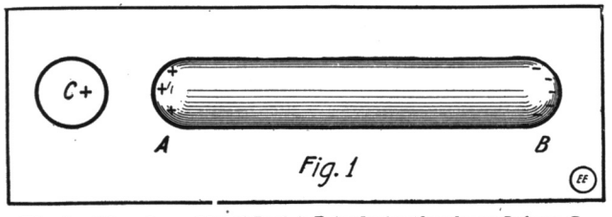


Fig. 1.—Charging a Metal Rod A-B by Induction from Sphere C.

A large amount of experimental work has been carried out during the past few years which throws a new light on the subject, and which gives new information as to the nature of electricity. One of the latest theories explaining this subject is the "electron theory," which has been developed by some of the most prominent scientific men of the world, particularly by Sir J. J. Thompson, who has devoted his entire time to the experimental side of matter and who is regarded universally to-day as an authority on the electron theory.

This theory states that a certain amount of positive electricity forms the nucleus of every atom; around this nucleus a large number of negative particles revolve, which are called the electrons. Each of these minute electrified particles has a mass approximately 1/1760 of that of a hydrogen atom and carries an electrical negative charge of .000,000,000,3 + electrostatic units. The electron is a disembodied electrical charge in rapid motion containing no matter, but it is the ultimate constituent of matter and is the same in every substance, but different in number per unit volume. The fundamental assumption of the electron theory is that the electrical properties of matter can be explained as the action of particles, each carrying an electric charge. In all insulating subtances, the electrons, are kept in a fixed position by some elastic force, but in a conductor they move freely and this depends also upon the kind of conductor.

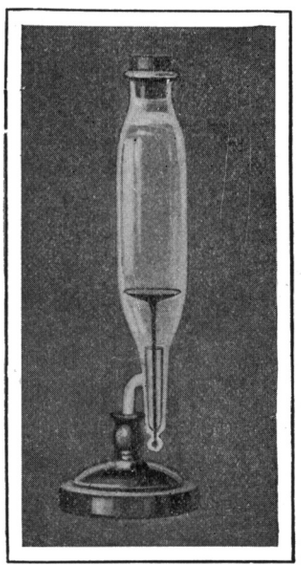


Fig. 3.—Novel Tube Useful in Determining Nature of Electricity.

It is quite evident that whenever a metallic object, such as rod A, B, Fig. 1, is charged by a sphere, C, by induction, the negative electrons stream away to the opposite end of the conductor and leaving a fixed positive charge at A. Since the electrons carry a negative charge, a current passing through a wire from right to left (positive to negative) is really nothing more or less than a stream of electrons moving in the opposite direction, from left to right. Although the electrons are so minute that they can move with ease through dense solids, their properties, the amount of charge, and their mass are definitely known and this wonderful work in determining the various properties of the electron has been actually carried out experimentally by Prof. Millikan of the University of Chicago. It is quite impossible for the writer to go into the confirmation of this theory in this short article, but that such particles as electrons really do exist and, moreover, possess distinct characteristic properties may be seen from the following experiment.

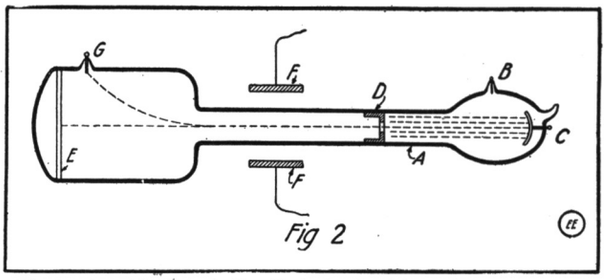


Fig. 2.—Special Cathode Ray Tube for Studying Their Characteristics.

It is evident that if we take a vacuum tube, such as that shown in Fig. 2, and excite it by a high-tension current, preferably direct, through terminals B and C, a steady stream of particles, the electrons, will be projected from the cathode C, which are thrown off at right angles to the face of the electrode. These particles passing through the diaphragm D, which consists of an aluminum cuplike partition, have in its center a small coaxial hole for permitting the electrons to pass through. As soon as the particles strike the screen E they will produce a yellowish green phosphorescence; this screen is usually coated with zinc sulphide. Now, if we place a magnet near the cathode ray it will be noted that the ray will be deflected and the amount of deflection will depend upon the strength and distance of the magnet acting upon the ray; this shows that these cathode rays are composed of a material which are deviated by magnetic force. Moreover, these rays travel with a high velocity and they can be harnessed to perform work. This is readily proven by placing a mica vane in such a manner so it can revolve freely and set in the path of the ray, the impact of the particles will cause the vane to rotate. By placing two plates, F, F, in the position as shown and charging them with a high-tension current, it will be found that the ray will be deflected as indicated, proving by the direction that these particles carry a negative charge. Now, if we deflect the ray so as to fall upon the conductor G, it will communicate a negative charge to G, establishing beyond doubt that the cathode ray is composed of a large number of particles bearing a negative charge. These charged particles are the same no matter what gas the tube contains and their mass equals approximately 1.1×10^{-24} grams, which is, of course, very minute as compared with the smallest particle that our mental vision can possibly conceive of. Fig. 3 depicts a photo of a vacuum tube used in determining the various properties of the cathode ray.

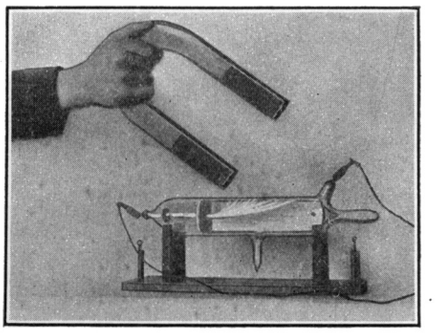


Fig. 5.—Cathode Ray Being Deflected by a Magnet

Another similar experiment which proves that the cathode rays are purely negatively charged particles was shown in a direct way by Perrin. Fig. 4 shows a modified tube that has been used for this experiment. The rays start from the cathode A and pass through a slit in a brass collar, B, which fits tightly into the neck of the tube; this collar is connected with the earth and used as an anode; the rays, after passing through the slit, enter the spherical vessel C. In this vessel are two spherical metal electrodes, the outer one, D, connecting with the earth, the inner

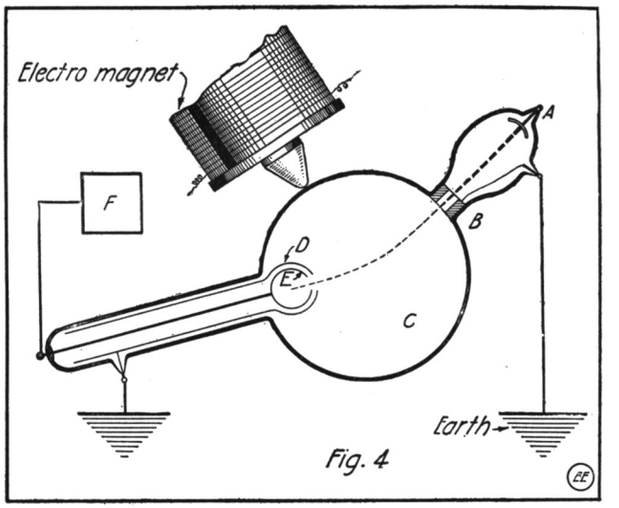


Fig. 4.—Evacuated Glass Bulb and Powerful Magnet Used to Prove Cathode Rays Are Negatively Charged Particles.

(*Continued on page 63*)

The Wireless Wizard's Ghostly Conspiracy

By Thomas W. Benson

"BUT, I tell you, I saw it, saw it with my own eyes. You fellows can laugh all right when you are here, but go past that house at night and there will be a blamed sight less bragging."

These words fell on our ears as we entered the rooms of the Gee Whiz Wireless Club. As the Wizard slid off his overcoat and tossed it on a chair, a smile flickered around his lips, but was it from the ludicrous tone of voice in which the half-scared youngster was defending himself, or was it from his usual insight into mysterious things happening in the neighborhood?

"What's up, gentlemen?" we butted in and the boy turned to us and began his disjointed tale. After questioning him and piecing it out, it seems that he was passing the "Coffin," a house so named from its peculiar ground plan, which had stood untenanted for years on old Asylum Pike. The gossips had it that a "haunt" cut up "high jinks" at times within the old, weather-beaten structure, but this was given little credence. The boy's tale, however, seemed to create ground for such thoughts since he had seen some hair-raising sights and heard some peculiar noises while coming to the meeting.

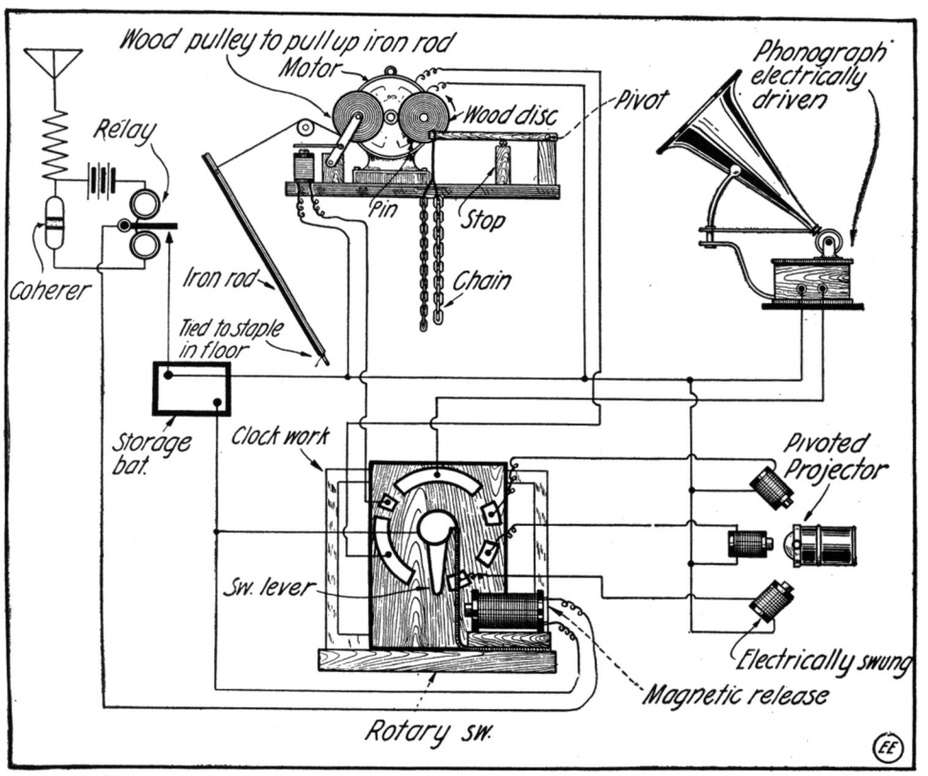
His description of the occurrence in so far as it was connected with the details of the celebration of visitors from other worlds was decidedly vague. This was no doubt due to the fact that fear distorts the mind and that most of his observations were taken over his shoulder when the road allowed him to detract his attention from it. In short, he preferred to run and see the sights another day.

His tale as a whole was met with incredulity and dropped from the club's thoughts for the moment. True to the member's code, all things must rest while the fate of radio telegraphy hung in the balance, for were not these enthusiasts gathered here the raw material from which the brilliant engineers of the future were to be made?

The meeting over, a council of war was held and it was arranged for a number of the members to witness the drama, so queerly staged, on the following night. Brave indeed were these Knights of the Key, buoyed up with the motto that there is safety in numbers, which fact holds good in love, war and nocturnal audiences.

At dusk the following evening a distant observer would have seen a dark patch moving eastward over Asylum Pike. A patch, that as it came closer, would have been seen to be a group of young men who looked furtively at the bushes along the roadsides and clung together as though drawn by an unseen power. They turned a bend in the road and the "Coffin" came into view.

After selecting a vantage point, paying all due attention to lines of retreat, they settled for the watch. The "Wiz" looked at his watch by the light of the moon, which showed ever and anon between the heavy clouds drifting across the sky. Everything was ready, the stage setting perfect. The building partially surrounded by massive oaks which left the front open, gave the necessary touch of desolation, heightened to a point to satisfy any stage manager, by the fast flitting shafts of mellow lunar light, that at times outlined the building as if sketched in silver, only to throw it into deeper darkness when Zeus, God of Storm, drove his minions across the sky. But who was to give the curtain cue? That was the question.



Simple Apparatus Used by the "Wireless Wiz" to Create the Haunted House Effect

Virtue is its own reward, but our patience was amply rewarded that night. A clanking of chains set our teeth on edge and our every muscle tensed as the metallic sound was wafted down on the night air. A mere rattle of a chain, yet what thrills it sends up a listener's back when he is properly keyed up by suspense and expectation of the unexpected.

Suddenly all sounds ceased and a shot rang out on an atmosphere that seemed to be held in tension by unseen forces. A shriek as of a damned soul sinking into the bottomless pit, a series of moans and a strident laugh seemed to release the tension suddenly and our hair had aviation tendencies to such an extent as to render evident the immediate loss of our hats and nerve. This latter virtue is also known in some circles as "brass" or impudence, but how wrong. We were anything but impudent just then.

Our eyes fairly started out of our sockets as a ghastly, grinning figure appeared at a window, to disappear only to appear at the next and then a third window. As we stared, yes, stared not unlike a soldier mentioned for heroism in face of the advancing enemy who was too scared to run, the figure dissolved into a red glow that illuminated all three windows.

The "Wiz," crouched at my side, started, then did the most unexpected thing of the whole evening, sprang to his feet and shouted: "Come on, fellows, follow me, we have something extra not scheduled to-night," and started at full speed for the house. Instantly we were after him, marveling, yet running like old time cross-country sprinters. A few stumbles, a wrenched ankle and a loss of breath were our sole injuries in the charge as we jumped across the veranda at the heels of our leader.

He had a key in the lock and a second later we marveled more, we were thundering up the stairs, pocket lights flashing as we followed him who seemed to be familiar with the surroundings in every way. How strange it seems as I look back on that night. A troup of badly scared fellows rushing into that ghostly structure. Was it auto-suggestion or reflex action? Did we automatically follow the Wizard's lead, or were we under such strain that his sudden words caused us to react and thus underrate the scene but a moment previous before our eyes and incite a desire to get at the bottom of it immediately?

Our headlong rush was stopped as soon as it was started by the sight of a closet in one of the rooms blazing.

"Into it, fellows," roared the "Wiz." He seized a piece of burlap lying handy and began to beat the flames. Our excitement and activity for the ensuing moments drove away all chance of thinking and it was only after the flames were subdued and five electric flashlights were boring the smoke in the closet, did we utter a sound. A laugh behind us caused us to whirl around because it sounded not unlike the laugh that had startled us a few minutes previously. Then dawn came and it burst on us in all the shining hues of the rainbow that the "Wiz" was back of all this mystery.

"Oh, you Wizard," we chorused, as we made for the closet to reveal its secrets. His work all right—batteries, wires, phonograph, clock work and the ruins of what appeared to be a projector were quickly recognized in turn.

"Ah, Ah! So *you* were the host of the spirits," some remarked, "now be the press agent for the same occasion. How did you do it?"

"Dope it out yourself for a change, my dear boys, and teach yourselves the rudiments of the Black Art."

(*Continued on page 59*)

The Joys of Blundering

By THOMAS REED

THAT good lad Harold Power (whose reputation is mounting as high as that new wireless tower out at Tufts College) was interviewed the other day by a reporter for a daily newspaper.

You know these reporter fellows always have to work in a certain amount of "heart-interest," otherwise known as "sob stuff," to make a hit with their editors; so this one turned it on by the kilowatt while he described our bold Harold's first little receiving set—how it wouldn't work, and the brave boy kept at it for months in the face of bitter, bitter disappointment; and one day when he was almost ready to sell the old homestead for a pittance and go forth into the snowstorm with the che-ild wrapped only in the usual plaid shawl, he got a faint, *faint* buzz in his receiver, which he nursed along until it developed into a full-fledged weather-report from the Navy Yard predicting Fair and Warmer for Tuesday, and victory was his!

From a daily-paper standpoint it was a beaut; it wrung the heart a good husky wring, and then dissolved into a snappy brush-discharge of innocent glee, worthy of the best traditions of the Christmas Story.

Outside of one thing it was all right; and that is that a real experimenter never feels that Eliza-crossing-the-ice depression when his home-made "rinktum" won't work. It doesn't discourage him a bit; he just gets interested. If others have got buzzes out of the air, by heck! his apparatus is going to do it or he'll know the reason why. The hunt for the trouble is the real fun of the game.

Wireless is always fun, but I believe I enjoyed my first blundering entrance into it most of all. Between ourselves, if I didn't actually welcome the blunders, at least I didn't turn them hungry from the door; for I am an "Old Bug" and I knew the pleasure coming to me.

It was my kid friend Stevie who inoculated me with the wireless germ. He brought to the house a scaly old tuning-coil wound on a paper tube, a home-made detector with a warty lump of silicon and a 500-ohm receiver that had seen better days. I had a massive condenser left over from some bygone experiment and with these we went to it, lured on by Stevie's positive assurance that once upon a time these rare specimens had "got" Wellfleet.

The paper tube had shrunk and the wire was loose; so with the neatness born of old habit I began by giving it a couple of nice fat coats of shellac. Two whole days I dried it over the register and it looked shiny and fine.

I was a little dubious about the bed-spring aerial; it looked positively inadequate after the tower I had just seen at Brant Rock, hundreds of feet high and with its various wires spreading over acres of ground. But Stevie hung doggedly to it that you could get *something* out of it, and it would do for a starter, so bed-spring it was.

". . . Stevie clamped the receiver on his head and began to stab his lump of silicon . . . . stab, stab—listen; stab, stab—listen, but nothing doing."

Stevie had sort of forgotten the hook-up, but he did the best he could, and with a wire run to a gas-pipe ground the preparations were complete. Stevie clamped the receiver on his head and began to stab his lump of silicon in its anatomy with his detector-point. Stab, stab—listen; stab, stab—listen; nothing doing! It was two o'clock of a Friday afternoon.

Stevie's forehead began to perspire. His reputation was at stake. He had promised me wonders and couldn't perform them. We went over all our connections and twisted them up as tight as Mary Ellen's ringlets; still nothing doing. We disconnected the bed and hitched onto a tin roof; if there was any better result it could be expressed by the variant—Nothing Didding. I believe it was so expressed.

Stevie was in despair, but one hope remained; wait till five o'clock when the Navy Yard came in; *that* was strong enough to do something for you. But five o'clock came and passed, and for all that wretched receiver said we might just as well have been listening through a doughnut!

Poor Stevie! his look was fairly hang-dog; but I was jubilant. This was something like. I took leave of my crestfallen friend and for three solid weeks I had the time of my life fussing with those strange instruments and re-fussing and super-fussing—learning something every minute.

At last one day in whistled old Mr. Navy Yard and sure he *was* strong. Talk about your bed-spring! I could disconnect the aerial entirely and catch him by his influence on the coil itself!

"So easy it seemed once found!" There were only three *principal* reasons why that first day's experiment was a fizzle. First and foremost my Aunt-Tabby solicitude in shellacking that coil had put a most effective kibosh on it; for shellac, unless dissolved in pure grain alcohol, contains enough water and other conductive impurities to shortcircuit the weak wireless current, and if we got anything that day it rambled over the surface of that coil like a goat in a ten-acre lot. While I fiddled and enjoyed myself, Mr. Coil was slowly drying out to the proper crispness; and when that moment came Br'er Navy Yard ceased to "lay low."

Secondly, our lump of silicon had been handled so much that it was covered with an oily film which prevented anything from coming through it; and

Thirdly, we had no buzzer-test, so that if we had had a sensitive spot we shouldn't have known it.

The secondly and thirdly remind me of a sermon, now I look at 'em. The usual collection will now be taken, Fellow-Bugs.

SEVEN MODERN WONDERS.

A London scientific society recently sent out communications to a list of a thousand scientists, selected from all the countries of the world, asking each to vote upon the achievements which, in his opinion, constituted the seven wonders of the modern world. The results, just made public, indicate how great a change has taken place in public opinion as to what constitutes a marvel.

Wireless telegraphy stands first. The telephone comes second. Radium was awarded a third place, but the aeroplane, coming fourth, was only five votes behind it. The analysis of the solar spectrum is reckoned the fifth wonder and the X-ray the sixth. The Panama Canal, which is more in keeping with the achievements formerly classed among the seven wonders, is placed last upon the list.

A large enough number of scientists regard anesthesia as a wonder to place it eighth upon the list. Only one man, a chemist of Munich, gave the seven in the order in which they are placed by the votes of the entire number.

ELECTRIC LIGHTS AID PRODUCTION OF EGGS.

For a long time poultrymen have contended that the short day was responsible for a short egg production.

"Many years ago," writes a California poultryman, "I conceived the idea that if I could only light my poultry houses in the winter and so get the birds to working as early as they are wont to do in the summer, it would not only be a benefit to the fowls in the matter of health, but would very materially help along the lines of egg production.

"I have installed two twenty-five-watt Mazda lights in each house, and from past records without the use of the lights I can say that the egg production since installing the lights has increased 40 per cent over any other year at this period. The lights are turned on about 4:45 a.m. and put out as soon as the birds can see."

Hatching and brooding of chicks by electric process has also come into vogue in the past year or two, and is meeting with great success. One thing sure is that the poultryman who is fortunate enough to be able to install electric incubators and brooders need not fear that his machines and brooders will go up in smoke from a faulty lamp or through the negligence of a careless employee.

UNIVERSITY OF IOWA RADIO NEWS.

The radio station of the University of Iowa at Iowa City, Iowa, sends out a brief QST report every Wednesday and Saturday night at 8:15 central time. The report contains university and wireless news items, results of inter-collegiate contests, etc. Immediately after signing off the operators will listen for calls from other stations. They will be pleased to make long distance tests at any time. The station call is 9 YA.

The Marvels of Modern Physics

By Rogers D. Rusk
Assistant Instructor in Physics, Ohio Wesleyan University

The Electric Theory of Matter.

THE electric age upon which the world is now entering has been heralded by scientific discoveries that are unparalleled in all history for number and brilliance. The idea that electricity and matter are inseparably connected if not one and the same has indicated the boundless extent of the field of electricity and its limitless possibilities. In addition, this idea marks a new epoch in the progress of science, by revealing to us many of the secrets of the real constitution of matter, and asserting conclusively the fundamental and universal character of electricity. A knowledge of these developments is essential to every experimenter, young or old, in order that he may readily grasp and understand the latest scientific achievements.

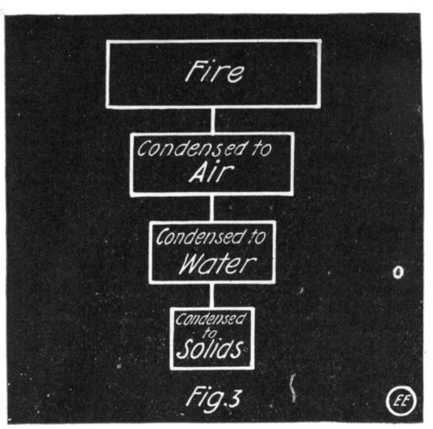
We might summarize the conclusions that have been reached by different investigators in the two following statements:

(1) It has been found that the atom is a complicated and divisible structure; and,

(2) The old theory that atoms are permanent or stable has been superseded by the theory that atoms are more or less unstable and changeable dynamic systems.

These two statements seem simple and complete in themselves, but they cover up a multitude of complications and scientific puzzles which we can do little more than outline here perhaps.

It is difficult to say just when the electric theory of matter originated. In 1881 Helmholtz reached the conclusion that if matter was atomic in nature, then electricity must be atomic also. This was an important step and was deduced from the experiments of Faraday, which proved that every monovalent ion in electrolytic solution carries exactly the same amount of electric charge (a monovalent ion being an electrically charged atom or group of atoms having the power to unite chemically with one atom of another substance). Now as the monovalent ion is the unit of matter in the solution, then its electric charge is assumed to be the unit or atom of electricity. Its numerical value may be determined by dividing the quantity of electricity



A Physical Transformation Theory 2500 Years Old

carried by a gram of hydrogen atoms (96,000 coulombs) by the number of atoms in a gram (6.1×10^{23}), which is equal to 1.58×10^{-19} coulombs.

Ten years before Helmholtz had suggested the atomic character of electricity, Varley, and later Crookes, found that the cathode rays discovered by Pluecker in

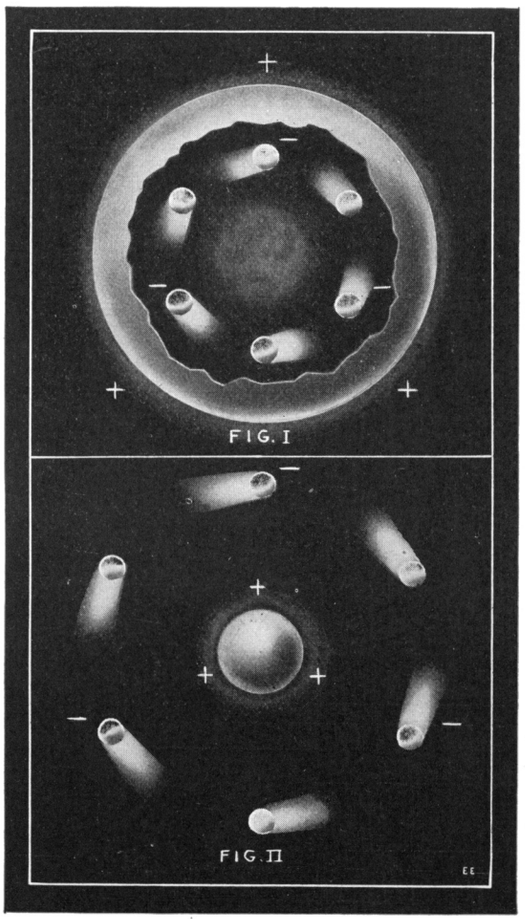


Fig. 1.—The Thomson Atomic Theory. Fig. 2.—Approved Atomic Structure; Negative Particles (electrons) Revolve Around a Central Positive Nucleus

1859 were really negatively electrified particles, instead of invisible light waves. In the last few years these particles or electrons as they are now called have been caught and measured by Millikan, Rutherford, and others. Furthermore, by the use of the electric discharge tube and with various elements as electrodes it has been shown that these negatively charged particles exist throughout all matter. To explain the different phenomena it has been necessary to assume also the existence of small positively charged particles, but it has been impossible to isolate any positively charged particle smaller than the hydrogen atom.

We can only assume that there must exist an elemental particle which is positively charged, and it seems probable that all matter may be made up of various combinations of these positive and negative particles. That this is the general opinion is the result of recent developments, and the extensive experimentation which has been carried on in this field. It is remarkable that of the different values obtained for the elemental charge (e) by at least eight different methods, there has been a variation of less than 3%, and many other measurements have been made of a like accuracy. These measurements aim to make it possible for us to deduce the relation of the particles in the atom, or the mechanical structure of the atom.

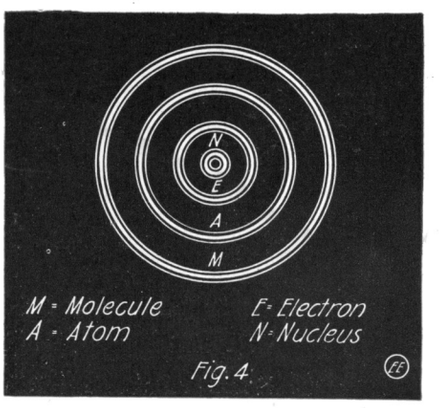
Our present knowledge of the electron consists for the most part of three of its properties, mass (m), electric charge (e), and velocity (v). The ratio of the first two is, as already suggested, a constant quantity, the value of which was early determined. So it is shown that if either one is known the other can be found. The value of (e) is given above, and (m) is found to be 1/1760 of the mass of an atom of hydrogen. The velocity with which the free electron may travel has been determined by other means as approaching the velocity of light (186,000 miles per sec.). From these facts and other considerations, many theories as to the structure of the atom have been advanced. Two of these which are radically opposed to each other have stood out as leaders.

About ten years ago J. J. Thomson began developing a theory suggested by Lord Kelvin, that the atom consists of a positively charged sphere within which the negative particles are rotating. This theory, which is shown in Fig. 1, was quite a popular one for a time, because of the satisfactory way in which it apparently explained the different properties of the atoms. In the last year or so experiments have been performed by Rutherford, that tend to disprove the Thomson theory.

Electrons are so small and travel at such high velocities that they have the power of actually penetrating the atoms of a substance. Now Rutherford, in what is known as his famous "scattering experiment," found that when this occurred the electrons were deflected by the charges in the atom to a degree which would be impossible if the positive charge surrounded the negative. This was sufficient to turn the tide of scientific favor toward the theory which Rutherford had already advanced, that the electrons revolve *about* a positive center or nucleus, and not within it. This theory is shown by the diagram Fig. 2, where as in the preceding figure the electron is represented by a dot and the positive particle by a circle. It will be noted again by these diagrams that one theory is the converse of the other.

These theories are vital because they explain phenomena which could not be explained by any previous theories, and the Rutherford atom, as it is called, will continue in favor as long as it serves to ex-

(*Continued on page 57*)



How the Nucleus N Forms the Centre of Activity in the Electron E, And in Turn the Atom A, and Finally the Molecule M.

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

The Washington's Birthday Amateur Radio Relay

By W. H. Kirwan (9 XE).

AFTER the Rotary M. S. G. (Message) of December 31, 1915, which appeared to interest most of the wireless amateurs throughout the country, the author decided to provide another test on Washington's Birthday. Owing to the fact that nearly all the amateurs appeared to be floundering around at night without any real purpose in view, the idea of a nation-wide relay suggested itself.

As February twenty-second was celebrated throughout the country as a national holiday, the night of February twenty-first was selected as the proper time to start the relay. Colonel Nicholson, U.S.A., was consulted at the Rock Island Arsenal and he promised to co-operate by sending a characteristic Birthday Message to this station just before the time of delivery, which was arranged as eleven p.m. Central Time.

Strange as it may seem, the Rock Island Arsenal does not have a wireless station and recourse was had to a messenger on foot to deliver the M.S.G. to my station (9 XE) in Davenport, which is only about one-half mile away, but within signaling distance for either wigwag or semaphore.

Hundreds of letters were written to the best amateur transmitting and receiving stations and certain questions were asked about range (sending, receiving) and wave length. Some answered at once, others tardily and the rest not at all.

By using a large map of the United States and a pair of compasses scaled to the alleged sending radius of the sending stations, and using the points on the map where the sending stations were located, a series of overlapping circles were drawn which completely covered the United States, with the exception of several places in the western desert and mountain country.

The most efficient wave length of the sending stations being known, a sheet of final instructions was printed, giving first—general information, next instructions to amateurs, then instructions to sending stations. This was followed by a list of sending stations, their time, wave length, and number of times they would repeat the M. S. G.

One thousand of these instructions were mailed broadcast over the country, so that all cities and states would be represented. Particular attention had to be paid to those states where the Governor lived in an inaccessible place by wireless, and extra instructions were mailed to the closest stations to deliver M. S. G. by Western Union or through the agency of the Boy Scouts. The final results of this relay naturally

1.—W. H. Kirwan, who sent out Washington's Birthday Message, call 9XE; 2—Station of Mr. and Mrs. Chas. Candler, St. Mary's O., call 8 N H; 3—T. C. Rice, Lincoln, Neb., call 9XT; 4—W. A. Allison, Worcester, Mass.; 5—Rev. Melvin Locke, Independence, Iowa, call 9IN; 6—J. W. Hubbard, Port Chester, N. Y; 7.—Willie Antony, Shreveport, La., call 4 C K.

hinged upon the successful reception and relaying of the M. S. G. by the respective stations, as per schedule. This was a long shot, but, with only two exceptions, was there any real confusion.

You all probably heard N.A.A. and the other government stations send out the general warning for all amateurs to refrain from sending after the routine report of February twenty-first and this was brought about by the sponsor of this relay calling upon the Secretary of the Navy and urging his help and co-operation in this relay. Captain Bullard was consulted and readily assented. It seems that our earnest endeavors were appreciated by these gentlemen and their co-operation was the result. This proves one thing to the satisfaction of the most skeptical, and that is, the Department of Radio Service is ready and willing to help us when we show a determination to help ourselves and obey the really few and very reasonable laws governing the use of wireless apparatus.

No one, therefore, appears to be gunning for the amateur. That which often seems like hard luck and persecution at times is really the result of disobeying the law knowingly or otherwise.

Nearly all the leading educational institutions throughout the country enlisted for this relay, as well as all the star stations of the A.R.R.L. and several National Guard Signal Corps. Arrangements were made in the final instructions for a series of checking stations to work after the M. S. G. had been passed on by the regular sending stations and these boys surely did good work.

As a preliminary test, 9 XE arranged to use the same time and wave length, etc., of all sending stations on Friday preceding the relay, sending out a Q.S.T., Q.R.V. and sign, using up the time allowance on final instructions.

Old Baron Münchhausen was evidently at work this night, as the static Q.R.N. was so bad that, had the relay been picked for this night it positively could never have left the confines of the state of Iowa. This shows our extreme helplessness in cases of this kind and suggests that for a real relay service, to be of any use to our government, we must be able to work under the "worst" conditions and not the "best."

Moreover, nearly all sending stations rely upon local power companies for their primary current and these places, as well as the water works and custom houses are always the first to be taken by an enemy. This suggests that the most reliable relay station should have an auxiliary storage battery or gasoline engine with motor gen-

ON the eve of Washington's Birthday last, our Wireless Amateurs performed the notable feat of relaying a Wireless Message from one end of the United States to the other. Originating with an amateur in Davenport, Ia., the message was relayed by Wireless Amateurs to President Wilson, as well as to thirty-seven Governors in as many States, and to 137 Mayors. Read this eloquent appeal of the radio amateurs who may serve their country in the event of war, and learn what they have actually accomplished.

erator, so that the source of power can be relied upon in emergencies.

At last the night of the relay rolled around and the writer was very busy answering long distance requests for copy of M. S. G. and also trying to keep the reporters for the Associated Press from climbing in the windows, but no one knew the real M. S. G. until it had been received by 9 XE and sent hurtling through the ether forthwith.

The M. S. G. was copied at once by 9 YA and followed slowly down the line east and west, north and south. The following sending stations received and sent the M. S. G.: 9 YA, 9 XL, 9 ZS, 9 XV, 9 JN, 9 Y1, 5 BJ, 9 ZA, 9 YT, 9 YE, 5 Z1, 8QJ, 1 ZM, 2 FH, 9 PC, 8 YL, 8 ZU, 8 ZW, 8 Y1, 8 YC, 2 ZB, 2 SX, 1 ZM, 2 JD, 1 ZD, 1 AT, 3 YN. The following checking stations received and sent the M. S. G. after above stations had finished: 8 ZT, 8 XO, 3 ZS, 5 ZN, 3 KA, 3 DS, 9 BD, 9 DB, 8 ZC, 9 LT, 1 AS.

The author has grown up with wireless work, having been in the U. S. Navy at the time of the first experimental work in wireless, but never in his experience has he ever heard the air so still and quiet as on the night of February 21, 1916. Q.R.N. was not bad, but several commercial stations in their routine work caused a little inconvenience. Many of the sending stations were on a commercial wave and naturally caused a little confusion. Several impatient amateurs in the East also caused a lot of trouble by calling on a Q.S.T. and asking for M. S. G., because a little break down out West had caused a slight gap and disarranged the schedule somewhat. In war times these fellows would be shot at sunrise, but nothing will be done at present with them unless it will be to state that "no one ever gets anywhere who cannot obey orders!"

Three telegrams were received early Washington's Birthday from Hiram P. Maxim, 1 ZM, Hartford, Conn.; H. W. Blagen, 7 DJ, Hoquiam, Wash., and W. J. King, 5 CL, New Orleans, La.

Letters continued pouring in from all parts of the country and a summary of them showed that the M. S. G. had been delivered to 37 Governors, 129 Mayors, 6 Town Commissioners, 2 Constables and last, but not least, to the President of the United States.

Mr. W. A. Parks, 3 D.S., Washington, D.C., received the M. S. G. direct from J. C. Stroebel, 8 ZW, Wheeling, W. Va., and mounted his motorcycle at about two a.m. and delivered the M. S. G. to the President's bodyguard at the White House in Washington, D.C.

It may interest the readers to know that there were millionaires and poor, hard-working farm boys, several priests, six ministers, three ladies and numbers of radio clubs, schools, boy scouts and all working on this relay, and they did the trick in good shape, just like Americans can do when they get started.

Several amusing incidents occurred during the relay. The Mayor of Dubuque, Iowa, was so enthusiastic over the scheme that several members of the Mississippi Valley Wireless Association took him to their station and strapped a pair of 2000 ohm. 'phones to his ears. He heard his first wireless signal that night.

H. E. Rawson of Kuna, Idaho, picked up the message three times from 9 XN, 9 ZA and 7 BD. He lives on a large ranch, and, being about twenty-five miles from the Governor in Boise and not caring to spoil the spirit of the M. S. G. by telephoning it, says he "put out the cat, locked up the dog, put the canary bird in the cupboard and, with his wife, went to the barn and, after talking friendly for awhile to his Ford roadster—like a Southern darky talks to a mule—both of them started out of Kuna for Boise at midnight, across the prairies and delivered the M. S. G. to the Governor of his state and the author has the receipt for it.

Rev. Ruth of St. Martin's College, Lacey, Wash., had a hard time receiving the M. S. G. He says the allies were against us as the British station at Vancouver, B.C., called an "imaginary" warship for one and one-half solid hours. Must have sounded like some of our amateurs calling the boy in the next block.

Several boys were ill and in bed at the time of the relay, but against the doctors' orders slipped on the 'phones, tuned up, received the M. S. G. and had the Boy Scouts deliver it.

A summary of the test follows: M. S. G. delivered on Atlantic and Pacific Coasts in one hour from Davenport, Iowa. M. S. G. delivered in twenty minutes to Mexican and Canadian borders. M. S. G. delivered to the President of the United States. M. S. G. delivered to thirty-seven governors of as many states. M. S. G. delivered to 137 heads of cities.

A considerable number of the boys took the "signature" for granted, however, and the good Colonel W. P. Nicholson, U.S.A., was called everything from plain Nick to Richardson. The body of the M. S. G., however, suffered only the addition of one word toward the east coast, and the loss of an unimportant word by the time it reached the west coast.

The original M. S. G. is as follows: **"Q.S.T. Amateur Relay. A democracy requires that a people who govern and educate themselves should be so armed and disciplined that they can protect themselves.**
(Signed) Colonel Nicholson, U.S.A."

To further interest the amateur, another relay will be started soon by 9 XE and code will be used. It will be delivered to all the forts and naval yards of the country where possible. By using code the army and navy officials will be able to read the M. S. G. if correctly received. It must be correctly received or it will lose its meaning. Amateurs will not be able to guess at the balance of the M. S. G. like some did on the last relay. Further, the Associated Press will be asked to co-operate with us by not taking the M. S. G. and using the land lines to forward for publication.

The author is seriously considering a daylight relay, but this will all depend on the results of conferences with the Army and Navy officials. I give herewith an honor list of those who made prompt report after relay. These are complete nad are, of course, in excess of the regular sending stations.

My most earnest thanks to those who helped in this memorable work is hereby extended, through *The Electrical Experimenter,* which very kindly sent out the preliminary notice and assisted in the general results.

A great many others received the M. S. G. but did not report to 9 XE from whom they received the M. S. G. Owing to the fact that the Associated Press had M. S. G. next morning, these stations could not conscientiously be credited, as they had all received final instructions explaining how to report.

(*Continued on page 64*)

DO YOU

own a wireless station, either for sending or receiving? If you do, don't fail to join the greatest Wireless Association in the country: THE RADIO LEAGUE OF AMERICA. If you believe in the preparedness of your country, if you wish to help Uncle Sam, if you wish to have your station **officially** recognized, join the LEAGUE, a national, non-money-making organization. Beautiful engraved and sealed certificate, FREE to all members. NO DUES OR FEES WHATSOEVER.

Honorary Members: W. H. G. BULLARD, U. S. N.; PROF. REGINALD A. FESSENDEN; DR. LEE DE FOREST; DR. NICOLA TESLA.

Send stamp for large 8-page information booklet. **DO IT NOW.**

AMATEUR WIRELESS MEN FORM SIGNAL CORPS

Following a plea for voluntary civilian training as part of national preparedness, 50 amateur radio operators organized a volunteer signal corps at Columbia University on Feb. 8 last. A meeting of the radio operators had been called by the National Amateur Wireless Association. J. Andrew White, actin- president of the association, presided.

The newly organized company probably will be afforded the use of the apparatus and facilities of the First Signal Corps, N. G. N. Y., and the volunteers will start immediately to learn their duties under army officers.

PRESCRIPTION SENT BY WIRELESS SAVES BABE.

A wireless message from a ship several hundred miles away was picked up by the Cape Hatteras station and was of such unusual nature that it is believed to be the first of its kind ever flashed through the air with successful results.

The message stated that a baby on board the vessel was critically ill and that the ship's physician was baffled by the malady of the child.

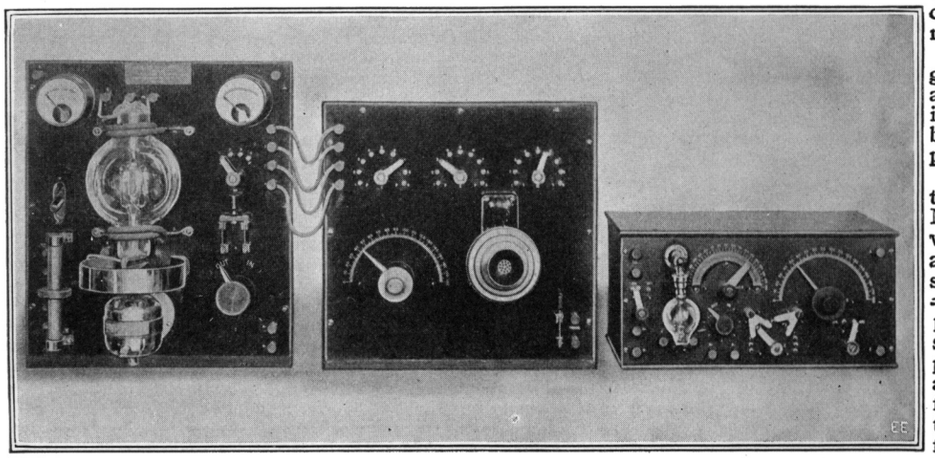
The wireless stated that the doctor had exhausted his medical skill without avail, and made a pitiful appeal on the part of the broken-hearted mother of the child of any physician who might get the radio and be able to prescribe for the infant.

With the symptoms given, the operator at Hatteras sent the message to Dr. Sutton, two miles away from the station. The doctor gave the operator a prescription and the latter at once flashed it through the air.

A few hours later the operator received another wireless saying the prescription had been filled from the ship's pharmacy and that the child had shown immediate improvement.

Latest Radio Telephone Apparatus

THE problem of developing an apparatus which can easily be manipulated by the experimenter has kept the minds of the radio engineer busy for years, but none of them has succeeded in solving the problem until the inventor of the audion, Dr. Lee De Forest, finally perfected his audion tube type radio telephone apparatus which has proven very successful. This apparatus is shown herewith.



Improved Vacuum Bulb Generator Type of De Forest Radiophone Sending and Receiving Apparatus.

The cabinet at the left contains the oscillion tube as perceived. This is more or less an audion bulb of special design of large size. The motor shown below the oscillion bulb carries a fan, which is used for cooling the bulb when it is in operating condition. The rod seen on the left of the motor is a potentiometer of the carbon type employed for regulating the high tension current between the grid and wing of the oscillion. The circular knob located at the lower right corner of the cabinet operates the rheostat in the filament circuit. The rheostat is enclosed in the case. The switch just above the knob is used for connecting the fan motor with the line current. The intensity of current flowing through the filament is observed on an ammeter shown in the upper right corner, while the small handle below the hot wire ammeter (at left) is an aerial switch. When thrown up it connects the antenna to the instruments.

The necessary inductances and capacities are placed in a separate case and this is depicted in the center of the photo. The three sets of switches perceived on the upper side of the panel are used for controlling the inductance coils, which are placed inside of the case. The capacity is obtained from a rotary variable condenser, the capacity of which is regulated by turning the knob perceived at the left of the center cabinet. The telephone transmitter, which is clearly seen, is placed on a movable bracket. It was especially designed for controlling heavy currents without heating. The case is built large for the purpose of having a greater radiating surface. The small single blade switch located at the right of the microphone is used to connect the telephone transmitter with the batteries which are linked to the two binding posts placed to the right of the switch.

In order to operate this outfit it is only necessary to connect up the proper binding posts to the antenna, the ground and the batteries for operating the telephone transmitter and lighting the filament of the oscillion tube. Then by adjusting the various inductance coils and condenser until the maximum reading is obtained from the hot wire ammeter, the set is ready for transmitting speech. It is not necessary to speak loudly into the transmitter, as was the case in the former radio telephone apparatus which use the arc and the high frequency generator method of producing high frequency currents. The articulation of the speech heard at the receiving end is almost perfect and in fact is clearer than the wire telephone, the rattling noises in the receiver of which we are all familiar with.

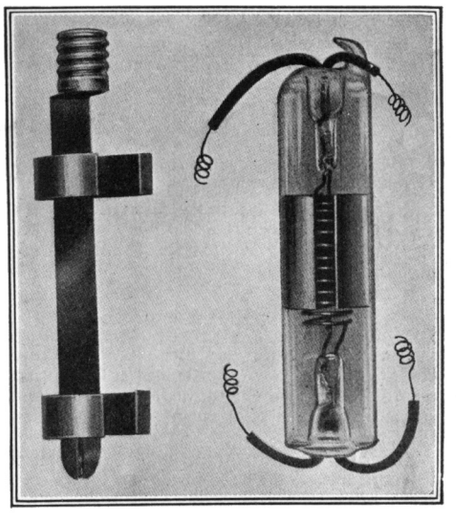
It is claimed that with this apparatus conversation has been carried on for about fifty miles, which is a remarkable distance considering the size of the apparatus. This was accomplished only by the perfection of the audion for the production of high frequency currents with a high amperage output. The oscillion tube here shown develops about 4 amperes radio frequency undamped current.

It is hoped that a still simpler radio telephone apparatus will be developed for the use of the experimenter and others who are undoubtedly looking for simple and inexpensive instruments of this nature.

At last an audion detector has been developed which can be used for practically any circuit, that is, some of the old audion tubes were not suitable for amplifiers and especially for oscillating circuits. However, the new audion tube recently devised is suitable for these special purposes. As shown, it consists of an evacuated glass tube in which a grid, wing and filament are placed. The grid consists of a copper spiral suspended between the two ends, as perceived, while the wing is a cylindrical aluminum cylinder encircling the wing and filament. This filament is a straight tungsten wire. It is said that the life of this filament is considerably longer than the usual type.

A suitable holder is also provided and may be observed at the left of the tube. The receptacle cap located on the top of the holder can be used for connecting the audion in any standard socket.

The sensitiveness of this audion tube is much higher in comparison to the old type. This is due to the greater ionic surface exposed to the hot filament. The filament of these tubes are run at very low temperatures and thus their life is prolonged considerably.



Latest Audion Detector and Holder Adapted to Screw Into Any Standard Socket.

This new audion tube will undoubtedly interest all amateurs and especially those who are working with amplifiers and oscillating circuits.

WIRELESS FOR FOG SIGNALS.

That an application of wireless telegraphy to the use of fog signals has been perfected and approved by the Government was brought out in a conference on "Recent Researches in Electricity" at the Bureau of Standards by E. B. Rosa, Ph.D., chief physicist of the United States Bureau of Standards at Washington, D.C.

The safety of ships in the future will be greatly enhanced by the new plan of radiating wireless alarms from lighthouses during a fog in all directions to be picked up by vessels, so that no other warning of the proximity of rocks will be needed.

The appliance now being tried out by the Bureau of Standards sends as far as Newfoundland and Porto Rico—each vessel will be supplied with a receiving apparatus and each danger spot along the Atlantic seaboard will have a sending station.

IMPROVED ROTARY QUENCHED SPARK GAP.

During the past few years a considerable amount of labor has been expended on the perfection of spark gaps which form an extremely important apparatus in radio transmitting sets. Before the campaign

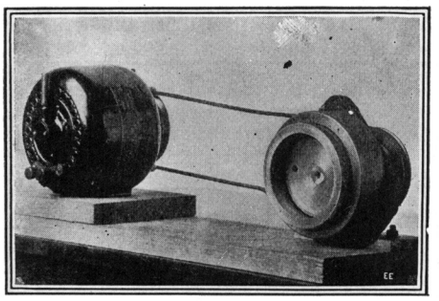
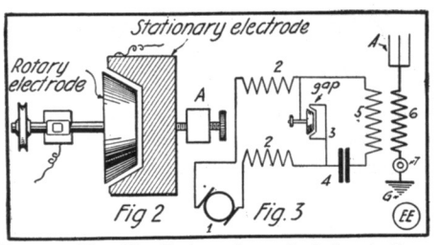


Fig. 1. New Form of Rotary Quenched Gap of Very Simple Design.

for improving the gap, the radio engineers thought it to be a minor point in the operation of the radio transmitter, but as the art advanced and as additional research work was conducted in this direction it was found that it played a very important role in the efficiency of the transmitting station. The rapid development of radio-telegraphy brought forth several new gaps which are undoubtedly familiar to the reader and are known to-day as the rotary, quenched, hytone, and compressed air spark gaps.

A very simple rotary quenched gap which exhibits considerable promise is shown in Fig. 1, and which is the invention of William Dubilier. This gap consists of a rotary electrode built as perceived in Fig. 2. It is fitted closely into a circular stationary electrode. The distance between the two is varied by adjusting screw A (Fig. 2). The rotor is rapidly revolved by means of a motor (see Fig. 1). The action of the gap when properly operated is the same as in the standard form quenched gap, but the improvement is that it constantly brings around new sparking surfaces, which is very important, as we well know.

This spark gap can be operated by either a direct current or alternating current supply. Fig. 3 illustrates the connections of the gap which is here being supplied from a direct current source. The generator 1 is connected to two choke coils 2, 2, which are used to prevent the high frequency current produced by the oscillating circuit 3 4 5 entering the dynamo. The spark gap 3 is shunted across the terminals of the choke coils, as perceived, while a condenser is connected in series with it through the primary 5 of an oscillation transformer having its secondary 6 connected to the aerial and the ground circuit



Details of Dubilier Rotary Quenched Spark Gap.

through a key or microphone 7, as depicted in illustration.

ADDITIONS TO LIST OF RADIO STATIONS.

The monthly statement of additions to the list of radio stations in this country has been issued by the United States Bureau of Navigation. There are 14 new ship stations and eight new special land stations. The new ship stations, with the owners of the respective vessels, are:

"Amazonia," R. Lawrence Smith, Inc.; "Arctic," Union Lumber Co.; "Catania," Huasteca Petroleum Co.; "Charles Pratt," Standard Oil Co. of New Jersey; "Dade," Miami Steamship Co.; "Diana," C. Ledyard Blair; "Floridian," American-Hawaiian Steamship Co.; "Healdton," Standard Oil Co. of New Jersey; "Henry Williams," Vacuum Oil Co.; "Jacob Jones," United States Naval Radio Service, Radio, Va.; "Munwood," Munson Steamship Co ; "New York," Texas Co.; "Santa Barbara," Atlantic & Pacific Steamship Co.; "Texas," Texas Co.

With three exceptions, these are uniformly of 300 and 600-wave lengths, in each instance. The "Arctic" is 300, 500 and 600, and the "Floridian" is 300, 450, 525 and 600. All except the two mentioned and the "Jacob Jones" use the Marconi system. The "Floridian" uses the Kilbourne & Clark, 240, system. The "Amazonia" and "Santa Barbara" are operated and controlled by the Marconi Co.; the "Arctic" by the Higgins Steamship Co.

The new special land stations, with persons or institutions controlling, are:

Columbia, Mo., wave lengths, 425 and 800, University of Missouri; Fall River, Mass., 200, 425 and 600, Harold C. Bowen; Lincoln, Neb., 300 and 450, Thomas C. Rice; Little Rock, Ark., 625 (variable), Ed Cornish; San Antonio, Tex., 300, 450 and 600,, Sidney Frederick; San Antonio, Tex., 200, 300 and 450, John C. Rodriguez; Seattle, Wash., 600 and 680 (variable), University of Washington; Worcester, Mass., variable, Worcester Polytechnic Institute.

The Sagaponack station of the Marconi Co., located at Long Island, N. Y., has been temporarily closed.

Wireless Aids Uncle Sam to Catch Villa.

The illustration here shown depicts a close view of one of the portable wireless outfits in use by the U.S. troops on the Mexican border and also the same type as that used by the punitive expedition of General Pershing, who has been able to keep up communication with his base eighty to one hundred miles away. These radio sets are the last word in scientific apparatus and the best that money and brains can build and are especially designed for rapid dismantling. The complete set, including the masts, can be erected or taken down within a few minutes' time. The majority of these outfits employ collapsible steel or wooden masts rising to an altitude of eighty feet.

They represent a wonderful advance over the old telegraph wire communication system used by armies in the previous wars or expeditions and, as a matter of fact, the auxiliary telegraph line laid by General Pershing's troops was cut or injured at over thirty different points along its length which, of course, put it practically out of commission. The wireless outfits have had to take care of all official communications aside from those in writing which have been carried back and forth by courier.

The portable radio trunk sets in use by the United States Army Signal Corps and the same as here illustrated have a range in temperate climates and under normal weather conditions of 100 to 125 miles. Some trouble has been experienced in Mexico in maintaining communication over such ranges with these small radio sets, but undoubtedly this trouble can be obviated by relaying the messages through a half way station situated say fifty miles from the Mexican border (General Funston's headquarters).

The transmitting set of these outfits comprises a 500 cycle, high-note generator, driven by a gasoline engine and in this way a suitable step-up transformer is operated to charge a condenser. This is used in the regular manner with a quenched spark gap. The receiving instruments are of the very highest grade and in most cases follow the designs of the Telefunken apparatus, which employs the extremely efficient variometer principle of tuning. In many respects these sets are quite identical to those used for field radio work by the German army.

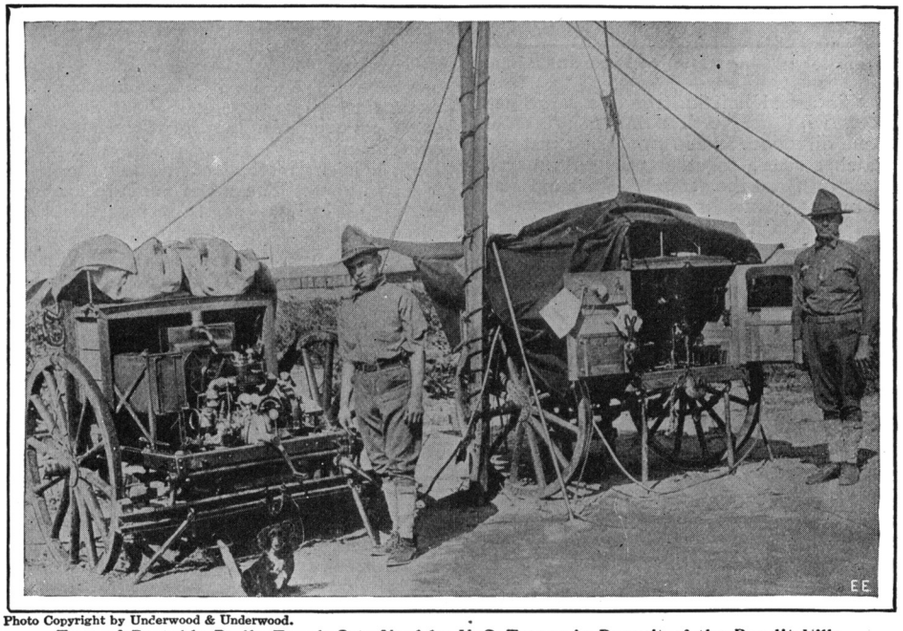


Photo Copyright by Underwood & Underwood.

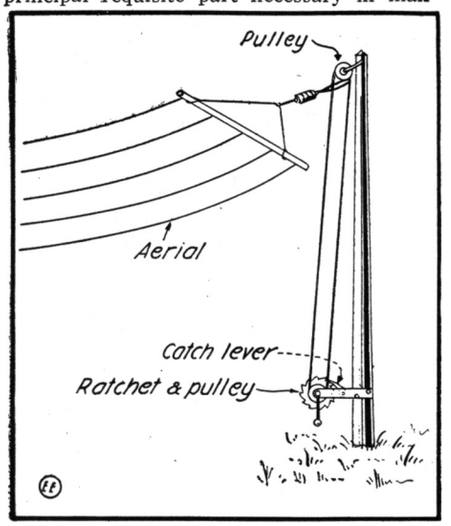
Type of Portable Radio Trunk Sets Used by U. S. Troops in Pursuit of the Bandit Villa.

BACK NUMBERS OF THE ELECTRICAL EXPERIMENTER.

Owing to the great demand for back numbers of *The Electrical Experimenter*, and the scarcity of them, the publishers have changed the usual price for them and a new schedule is now in effect, as follows: August '13, 20c.; December '13, 15c.; March '14, 15c.; May '14, 20c.; June '14, 15c.; July '14, 15c.; September '14, 10c.; November '14, 10c.; December '14, 10c.; January '15, 10c.; March '15, 10c.; June '15, 25c. All other copies dating from July '15 can be obtained at the regular price of 10 cents per copy. Address Subscription Department.

AN AERIAL HOISTING RIG.

For the radio experimenter who wishes to employ an easy method of raising and lowering his aerial for repairs, changes in connections, etc., there is suggested in the accompanying illustration an idea which can be carried out at small cost invariably. The principal requisite part necessary in making this aerial hoisting rig is a large gear wheel, with the teeth pointing preferably in one direction, as shown. Often just such a ratchet wheel, together with pall, may be picked up from the scrap heap around manufacturing plants, or it could be made out of a piece of hardwood, such as maple, 1 inch thick and 4 to 6 inches in diameter. As the handle is turned the rope is turned also as it passes around the grooved pulley secured to the ratchet wheel. The pall serves to hold the ratchet wheel at any desired position, and by simply taking hold of the handle and then releasing the pall the aerial can be lowered, et cetera.

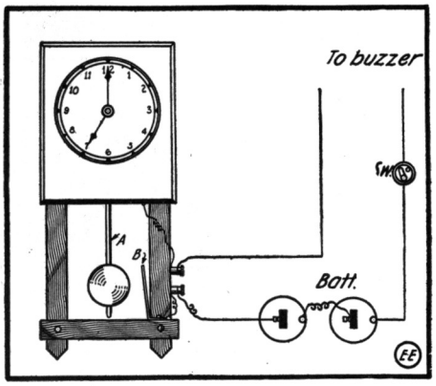


Scheme for Raising Aerial by Means of Ratchet Wheel and Crank.

Contributed by
THEODORE HIXSON.

AUTOMATIC RADIO BUZZER TEST.

I give herewith a description of an automatic buzzer test, which I have used on my wireless set and find it very efficient. In this scheme I use a clock; A, the pendulum which makes contact with spring B on the outward stroke. The switch Sw, which is to be closed until the detector is adjusted, and the wires to the buzzer and detector being connected in the usual manner. This automatic buzzer test eliminates the use of a push button to break the circuit, as the clock does it at regular intervals.



Clock Pendulum Makes and Breaks Test Buzzer Circuit.

Contributed by RAY J. FARMER.

A FEW POINTERS ON THE QUENCHED GAP.

The time is approaching when most of the amateur stations will use either quenched or rotary spark gaps as part of their equipment, whether they use a small spark coil or a transformer. However, as the rotary gap is usually too expensive for many amateurs, the quenched gap is taking its place and the purpose of this article is to describe a few designs of this highly efficient gap for use with sending stations, the owners of which are aiming for maximum results.

For small coils, quenched gaps may be made up from discs of zinc, copper or brass separated by mica washers. The metal discs may be cut out of sheet metal with a pair of sharp sheers and the washers made by scratching a piece of mica with a sharp pair of dividers. The usual size for the discs is about one inch in diameter and for the mica washers one and one-half inches in diameter by about one one-hundredth inch thick with the hole one-quarter inch in diameter. They are piled up beginning with a metal disc on which the mica washer is fastened with shellac (this should be used sparingly), then another disc and washer, finishing the pile with a metal disc. The sections should be pressed together as firmly as possible in a vise or clamp until dry. Six sections should be enough to raise the efficiency of a half-inch coil at least 10 per cent. A one-inch coil should have 12 discs and a two-inch coil about 20. The exact number can best be determined by experiment.

An efficient method of making the discs is as follows: The metal should be about one-eighth or one-quarter inch in thickness and should be grooved on each side about halfway between the center and the outside edge by covering with wax and removing a ring of it where the groove is to be, then pouring nitric acid on the bare portion. After about 20 minutes the wax may be removed with boiling water. The metal will be found to be smoothly grooved. The inside of the mica washer should come in the center of this groove to prevent being scorched by the spark.

For larger sets using transformers the metal discs are usually three and one-half to four inches in diameter. The mica rings must never be more than one one-hundredth of an inch in thickness. For a quarter kw. transformer four discs are used, for a half kw. six discs and for a one kw. transformer the usual number is eight. In nearly all cases where these gaps were tried out an increase in radiation of from 10 to 35 per cent. was obtained, and in one case a two-inch coil which under ordinary conditions could cover but eight miles sent 18 miles and over when equipped with a quenched gap.

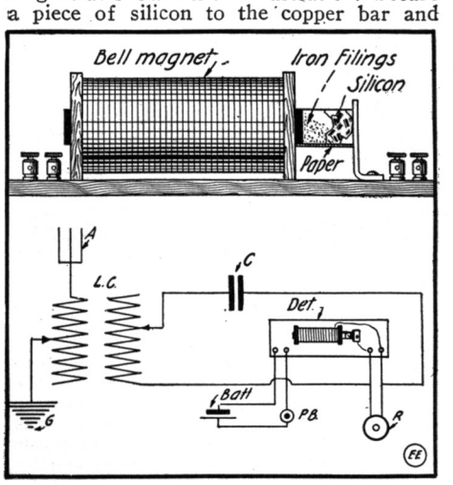
Another idea which may be used with great success in the ordinary sending station is the high potential choke coils used in the secondary condenser leads to choke back the surges from the sending condenser. They may be made by winding 20 or 30 turns of insulated wire on a form made of cardboard covered with shellac, porcelain, hard rubber or other insulating material. For small coils up to two inches No. 20 to 28 may be used, and for transformers No. 10 to 18 wire is best. At the ordinary frequency of 60 cycles the turns should be about two inches in diameter and one-half inch apart. For higher frequencies the wire should be spaced farther apart to obtain the best results.

When the quenched gap is used in connection with these coils the results are in some cases almost unbelievable and in all cases very satisfactory.

Contributed by AN EXPERIMENTER.

A MAGNETIC WIRELESS DETECTOR.

To make this detector fasten an ordinary bell magnet on a base made of wood. About a half inch away from it fasten a copper bar. Cut a piece of paper so as to fit in between the magnet and the copper bar, and bend it up around the core of the magnet as shown in the illustration. Secure a piece of silicon to the copper bar and fill in the space between the silicon and the core or the magnet with iron filings. Place two pairs of binding posts on the base; one pair at the right and the other at the left. Connect the copper bar to one of the right posts, and the core of the magnet to the other. To the other posts, connect the two wires from the magnet. Be sure the iron filings do not touch the copper bar, as it will make a short circuit.



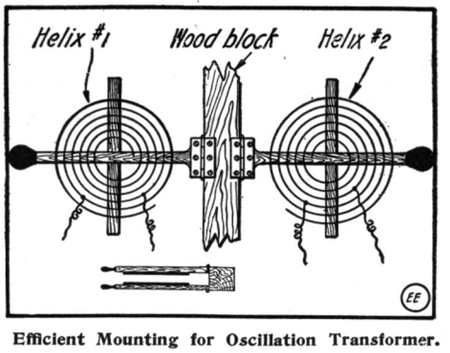
Electro-magnetic Control for Detector.

Connect the two right binding posts to the receiver and to the condenser, and loose coupler as shown in the diagram. To the left binding posts, connect a push button and a battery. When all connections are made it will be found that by pushing the button, the magnet will regulate the sensitivity of the detector.

Contributed by FRANK CUSACK.

A NOVEL MOUNTING FOR OSCILLATION TRANSFORMER.

Instead of using the sliding rod arrangement I have found that by the following method the rod on the oscillation transformer is done away with and much useful space is thus saved: Take the two pancakes of the transformer and on one end of each fasten a small hinge. Then screw the hinges and pancakes to a convenient base, leaving a space of 3 inches between the hinges. Now screw the base to the wall or back of the table. The coupling is varied by swinging one of the pancakes on its hinge. This is a very convenient arrangement where space is at a premium and is used by numerous commercial companies.



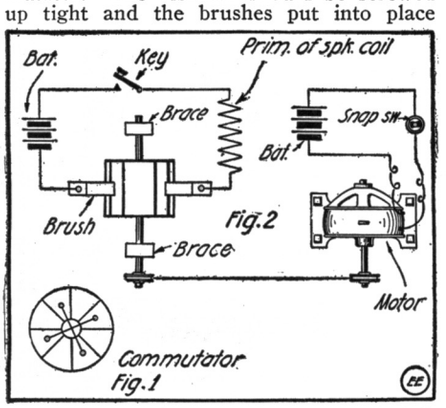
Efficient Mounting for Oscillation Transformer.

Contributed by PHILIP C. PLATT.

GETTING THE ROTARY GAP EFFECT WITH AN ORDINARY SPARK COIL.

The following device has proved to give a high, clear note with a spark coil. It also greatly increases the efficiency and range of a small spark coil transmitting set.

Procure a motor commutator with shaft, pulley and brushes. See that the commutator has an even number of segments. Cross connect every other segment with a small wire by soldering. Then make two wooden braces as shown in sketch to support commutator. A small battery or 110-volt motor should be used to turn the commutator. The vibrator should be screwed up tight and the brushes put into place



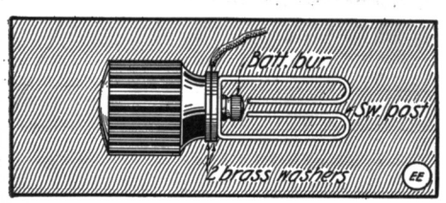
Utilizing Regular Commutator as Spark Coil Interrupter

against the commutator. This method will serve to make and break the current much faster and steadier than the ordinary vibrator and sounds very much like a rotary gap. A rotary or quenched gap gives good results in the secondary circuit when this device is used. The rotary gap, if used, should be mounted on the commutator shaft also.

Contributed by
RICHARD H. KNOPF, JR.

A GOOD HELIX CLIP.

Herewith is shown a clip for a helix or oscillation transformer. Such a clip can be made from a switch contact post, a knob and a No. 8-32 threaded brass bolt, such as are found on certain kinds of batteries. The switch post may be had at almost any supply house for five cents. The hole in the bottom of the post may have to be enlarged a little to permit the bolt passing through. A battery bur is screwed on to the head of the bolt to prevent the helix wire from slipping clear through the clip. Two washers and a suitable knob are then screwed



Effective Helix Clip Made from Switch Jaw

on. The instrument wire is placed between the washers and soldered to them in order to get a good contact.

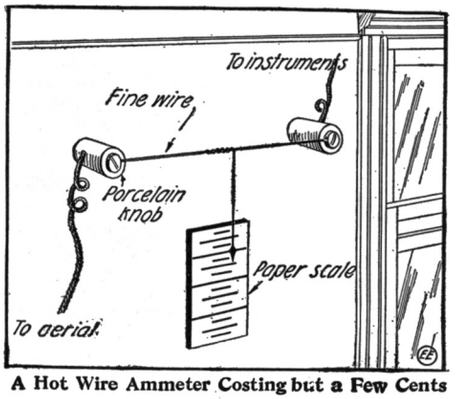
This clip makes a very good contact and will serve the purpose as well as a more expensive one.

Contributed by WINFRED SLAUSON.

A CHEAP HOT WIRE AMMETER.

There are all kinds of hot wire ammeters on the market, but in a great many cases the amateur does not care to spend even a reasonable amount for one, owing to the fact that he has but occasional use for such a device. For those having but slight use for such an instrument a design is here suggested which may be of service.

A piece of about No. 40 copper wire is stretched between two porcelain knobs



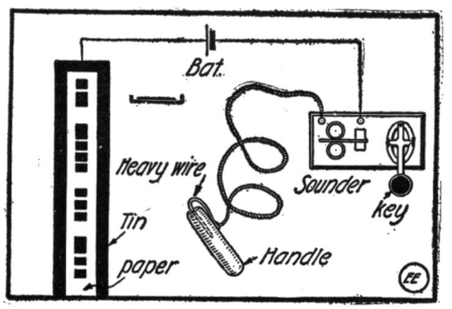
A Hot Wire Ammeter Costing but a Few Cents

with a small piece of wire depending from it at the center. Directly back of this indicating wire at the center of the span is placed a paper scale with a number of lines marked off on it, which may be spaced off with an ordinary rule. The more current there is passing through the wire between the two knobs as, for instance, when it is connected in series with an aerial of a radio transmitting set, the lower the indicating wire will drop on the scale. The scale should be calibrated to read correspondingly; e. g., low at the top and high at the bottom. This may be checked with a milli-ammeter, or roughly, with a pocket ammeter and a few dry cells. For heavier currents a stranded cable may be made up of a number of fine wires of the above mentioned gauge or slightly heavier; this size of copper wire has approximately the same high frequency resistance as that offered to the passage of a direct current. The distance between the two knobs will, of course, depend on the amount of current to be measured, but about three or four inches should be sufficient.

Contributed by
FRANCIS A. PRAY.

HOME-MADE TELEGRAPH INSTRUCTOR.

It may be a help to some who are learning telegraphy to make a simple code device as follows: First make up a little slide or trough of wood 18 inches long, 1 inch wide and ¾ inch deep; one-quarter strips will do. Cut a strip of tin or copper that will fit into this trough, and on this strip of tin paste a piece of paper that has been perforated with code letters, as a wide hole for a dash and a narrow hole for a dot. To the strip of tin connect a battery and the other wire of the battery to the sounder.



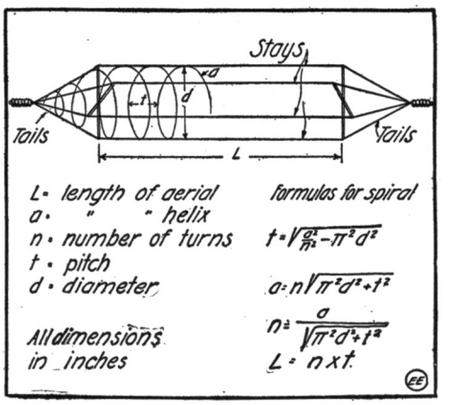
Telegraphic Code Instructor

To the second pole of the sounder connect a flexible wire. A piece of lamp cord about 2½ feet long is good, and to one end solder a piece of heavy wire about 3 inches long; bend it around the end of a stick ¾x¼x4 inches, which will be used as a handle, and then, after all the connections are made, draw this handle over the perforated paper, and thus the alphabet can be spelled off as rapidly as desired.

Contributed by MARTIN HOEFT.

DESIGNING SPIRAL AERIAL.

The best type of spiral aerial is made up of solid wire (either brass or aluminum), stranded wire being too flexible. The supports are made of common web binding about ½ inch in width and impregnated with paraffine wax. The length of the tails should be three times the diameter of the helix in inches. When ordering the wire, figure or plan your aerial by means



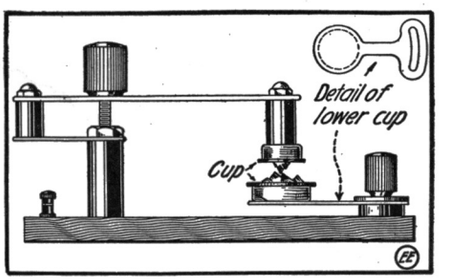
Design Data for Spiral Aerials.

of the formulae of construction given and have the dealer coil the wire with the required diameter, if possible, as this facilitates the building of same. The best way to construct this is as follows: Lay off upon the walls of your workshop, directly opposite each other and at equal heights from the floor, two circles of the same diameter as the coiled wire. If you intend using four stays fasten four cleats upon each 90 degrees of the circumference of the circle, then span the web stays and start the helix according to your selected pitch (1 inch being generally used). The wire is sewed to the stays with common saddlers' wax thread. This produces a fine aerial, which has given me good results and, moreover, is portable to the best degree.

Contributed by GEO. L. BOWMAN.

EASILY ADJUSTED DETECTOR STAND.

Silicon and antimony have been used in



Neat Detector Stand Suitable for Use with Two Minerals

this detector stand with best results, but a perikon combination will do also. A catwhisker can be used instead of the upper cup containing antimony. The parts of this detector are obtainable from any electric supply house. The base is made of bakelite, hard rubber, or hard wood, but bakelite is preferable. Sheet spring brass is used for the arm on lower (silicon) cup and on other parts not numbered.

Contributed by
FRANCIS R. PRAY.

Electrical Losses in Radio Transmitting and Receiving Sets

By James L. Green.

PART II.

THE RECEIVING SET.

HAVING concluded the consideration of the power losses in a radio transmitting set, we may now turn to those which occur in the receiving set. In the latter case the conservation of the received energy is extremely important, as this factor is so very small (amounting to a few microwatts in most cases).

Good connections and low high frequency resistance wiring are of prime importance. Induction and dead-end losses may cause a very great degree of inefficiency, and the kind of antenna used for receiving may either help or handicap an otherwise perfectly good set of apparatus. Let us consider, from left to right, the apparatus diagram in Fig. 2.

1. Antenna.—A good transmitting antenna may be a very poor receiving aerial, or vice versa. Of course, most any antenna will radiate energy to a certain extent. Its source of energy may be from a receiving set connected to it, or it may be from an electric wave coming in contact with it. This energy may be dissipated in one of two ways: i. e., 1. Radiated as electric waves. 2. To create sound in a telephone circuit as in a receiving set.

Since an antenna is desired which will transfer a maximum of energy to the detector circuit, a poorly radiative one must be built. Such an aerial would be one of low vertical height and great horizontal length.

2. Tuning Coils.—In amateur wireless sets the transformer (or loose coupler) used to transfer the energy from the antenna to the detector circuits is usually the source of considerable loss of power, due either to its design or to faulty construction.

1. No sliding contacts should be used, if possible. These are of high resistance, gather dirt, reduce the diameter of the wire at the point of contact and cause short-circuiting of adjacent turns by grinding metal dust into the interstices. Then, as to the methods of tuning, there are two methods of varying the wave length to which a receiving set is tuned.

a. By varying the number of turns in the several inductances.

b. By the use of variable condensers either in shunt or series as the case may require.

In connection with receiving tuners it is a fact worthy of consideration that the maximum strength of signals is obtained with any form of wave detector when the inductance of the secondary winding predominates, rather than the capacity, i. e., when the shunt capacity is of small value, as compared to the inductance value. On the other hand, better syntonic effects are secured when the capacity is of large value, as compared to the inductance. Thus the experimenter is forced to choose between strength of signals and perfect syntony.

Since, however, the audion is essentially a potentially operated detector, the secondary condenser should not have a maximum capacity greater than .0001 micro-farads. Again, coils should not be cut up into sections by having taps taken off at every few turns. This practise is a sure method of incurring dead-end losses. A more economical method of tuning would be to wind coils in separate, flat spirals of, say, 30 turns per spiral, making up a fair number of such units. Place connecting clips on each unit and when more inductance is desired place one unit beside another and snap the connectors into place.

The writer has experimented with a form of tuner shown in Fig. 3, and it certainly beats the ordinary form of loose coupler for receiving weak signals.

3. Condensers.—Since the chief losses in a condenser are those due to high voltage stress, the receiving condensers are usually quite efficient. There are, however, a few suggestions to offer here which may prove of value.

a. Keep the condensers "moisture and dustproof" to avoid leakage.

b. Keep them well removed from the magnetic field of tuning inductances to avoid induction losses.

c. Use only condensers which have low hysteresis loss; i. e., air insulated condensers.

4. Detectors.—The detector is the great energy-wasting instrument of the receiving set and in the case of crystal detectors this loss is practically unavoidable. The average crystal has a very high resistance and naturally loss of power through heating is encountered. If, however, the audion or *heterodyne* devices be used, conditions are reversed and amplification instead of loss of received energy takes place. These types of detector are, therefore, recommended.

MISCELLANEOUS NOTES.

a. Good connections are of prime importance in a wireless receiving set. Hence, all connections should be soldered, and all wiring composed of stranded wire or copper bar.

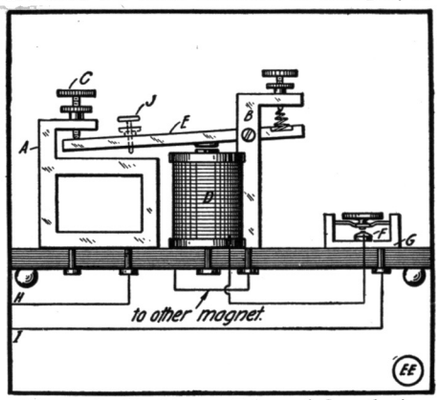
Switch contacts must be kept free from dirt, oxide, etc.

No iron or steel should be used, except, of course, where an audion amplifier is used; also, no nickelplated instruments should be used, for nickel is magnetic, and the high frequency currents will be affected by hysteresis loss; the worst fault of nickel being, however, its high electrical resistance, which is very noticeable where these "skin currents" are involved. Silverplating is recommended in general.

USING THE SOUNDER AS A BUZZER.

Those having telegraph sets would often like to have something which sounds more like a wireless message. In such a case it is not necessary to buy a buzzer set.

If the bridge A is connected with one of the binding posts one of the wires leading to the magnets to the part marked F on the key and the other wire connected to bridge B, the instrument will give a buzzing sound after a little adjustment. The screw J may either remain on the instrument or may be taken off. If it is left on it must not, however, be permitted to touch the bridge A. If two instruments are used the other need not be changed, as



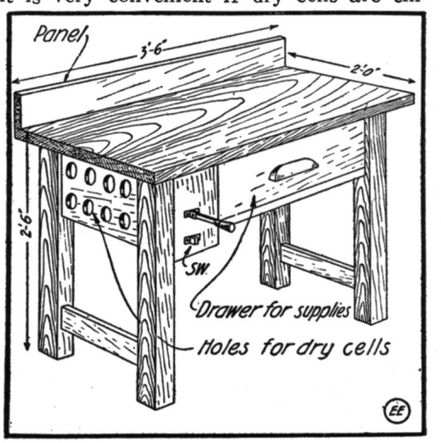
Scheme for Hooking up Telegraph Sounder to Act as Buzzer.

the alteration on the one will affect all other instruments used in connection with it.

Contributed by FRED KRUMMEL.

A HANDY WIRELESS TABLE.

A cheaply made, yet substantial, radio apparatus table, either for laboratory or operating requirements, may be made up as shown in the accompanying illustration. At one end of the table shelves are arranged to hold dry or storage cells, and it is very convenient if dry cells are employed to arrange the shelf so that they may lie sidewise on same. This leaves all the electrode terminals projecting outward so as to be easily accessible for changes in connections, etc. A battery switch and preferably a fuse may also be mounted on the front of the table.



Neat Design of Radio Table with Tool and Apparatus Drawer.

It will be found that a drawer placed as indicated in the illustration will be very handy for holding tools and miscellaneous parts, such as detector minerals, head sets, etc. The panel at the back of the table may be made of any desired height, but if it extends up farther than six inches, it should be braced by two iron shelf brackets, procurable at small cost from any hardware dealer. A number of the different instruments such as aerial switch, loading coils, etc., can be screwed fast to this upright panel.

Such a table can be built quite cheaply by any cabinet maker, but most of the readers will doubtless prefer to make it themselves. The greater part of the lumber may be obtained from a good size packing case, which may be procured from any large store for the asking in most instances.

Contributed by WILLIAM WIRE.

EXPERIMENTER HINTS.

These hints will be found of benefit to the experimenter with but little cash to spend for his outfit.

Tuning coil slider rods can be constructed very nicely from old gas fixtures made from square brass tubing. Before using, however, remove the lacquer with a piece of rag soaked in alcohol.

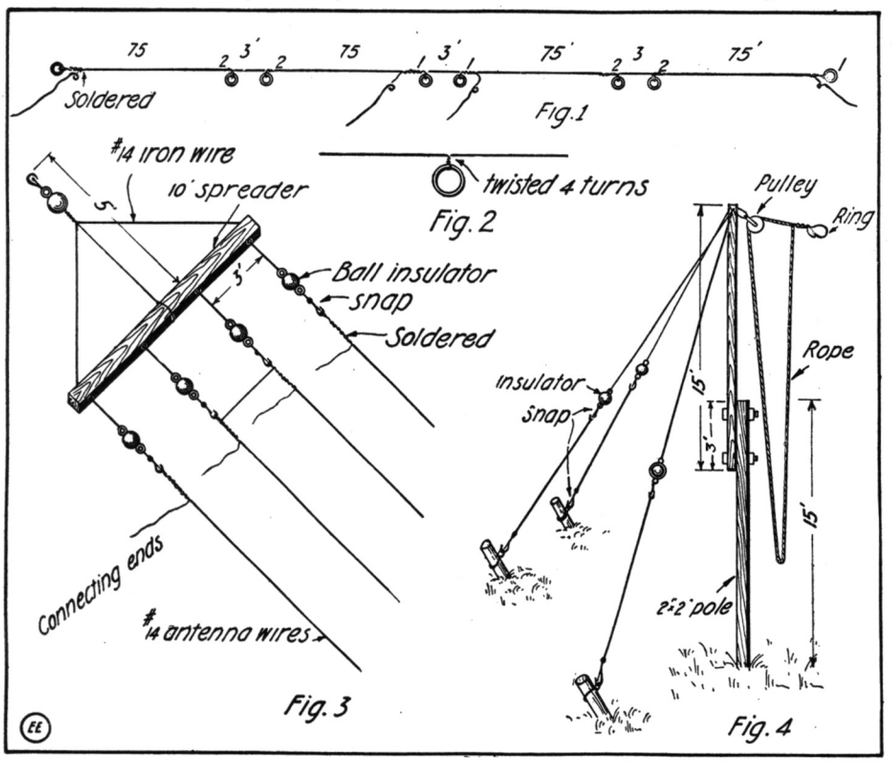
Very good hard rubber switch knobs can be obtained from broken snap switches. The hole is not tapped for a standard thread, but can be easily retapped with a 6-32 tap. The round knobs are preferable.

Do not throw away blown fuses of the cartridge type. Remove the small pins which hold the brass caps in place. They can then be easily removed from the fiber tube. If the lead wires and the lugs are removed by melting the solder with a torch the brass caps make excellent detector cups. If the lugs are straightened out and connected with a short piece of wire a good battery connector is the result. The fiber tubes should be kept, as a variety of uses will present themselves sooner or later to the experimenter.

Contributed by DAVID MATHISON.

PORTABLE AERIAL DESIGN.

A design of aerial for spring and summer scouting which is of simple construction, easily erected and compact is desired by many amateurs, especially the Boy Scouts.



Design for Portable Aerial and Mast Suitable for Boy Scout Maneuvers, Camping, Testing, Etc.

The aerial herewith described fulfills these requirements.

The aerial is constructed of Antenium wire, 430 feet being necessary. The design is laid out as depicted in Fig. 1. One-half-inch iron harness rings are placed on the wire and fastened in place as indicated in Fig. 2. After completing the aerial lay-out wind it upon a suitable reel and set aside. A 30-foot lead-in wire is now constructed of four 30-foot lengths of Antenium wire stranded together. The spreader is constructed, as shown in Fig. 3, of 2x2-inch straight grained pine, 10 feet long. The insulators may be either glazed porcelain cleats or ball antenna insulators. To each insulator there is fastened a small harness snap, as observed. The remainder of the construction is self-explanatory.

The poles are constructed, as shown in Fig. 4, of 2x2-inch pine. Two ½x5-inch bolts are required for each pol , large washers being used on both head and nut end of the bolts.

The upper lengths of the poles are 15 to 18 feet long and the lower lengths 15 feet. A 3-foot "lap" is used where the poles join, making the pole 27 feet high. Two poles of the above construction are to be used. Three guy wires are used per mast, each one being 40 feet long. The construction is easily understood by referring to the illustration. A pulley is placed on the top of each staff with a 50-foot ¼-inch cotton rope in each of them. A ring is then fastened to each rope as shown in Fig. 4.

The aerial is now ready to be erected. First the upper and lower sections of the poles are bolted together. The guy wires are then snapped together and the poles set up. Stakes which have been prepared are set about 25 feet from the pole base and arranged as seen in Fig. 4 for the guy wires to snap into. The poles are set about 80 to 90 feet apart. The aerial is now put together as shown in Fig. 1, rings No. 1 being snapped into one spreader, while rings No. 2 are snapped into the other.

The spreaders are then snapped onto the hoisting ropes, the lead-in wire connected to the aerial by a special antenna connector and the aerial erected.

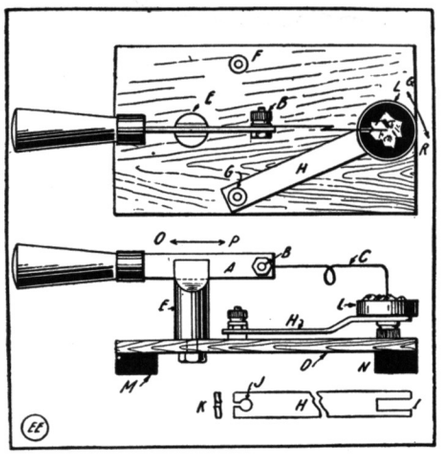
Two or more persons can, in a very short time, put up this aerial, which is capable of transmitting and receiving messages as efficiently as one of more permanent construction.

Contributed by
ARTHUR R. DARLING.

A CAT-WHISKER RADIO DETECTOR.

Here is a detector which is very easily made, quickly adjusted and fully as sensitive as many more elaborate ones.

A is a knife switch blade and E is the forward contact jaw from the same. B, F, G are binding posts taken from discarded dry cells. H is a brass strip, pivoted at J to post G, and having a slot I at the other end to receive the crystal cup and thus allowing the changing of cups. K shows how the pivot end is cut and bent to make good contact with G. The cat-whisker C is made of fine brass wire and held by nut B. D is the base, while M and N are hard rubber feet. The cup L is the brass cap from a battery carbon.



Detector Made from Knife Switch Parts.

Adjustment is accomplished by moving the handle up or down. The crystal may be spotted by moving A along line OP, also by swinging L along arc QR. Swing L clear of the base to change crystal.

Contributed by CARL McKETHEN.

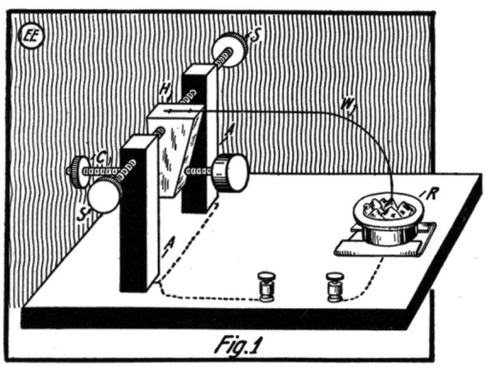
A BALANCED DETECTOR.

As I have never seen an article explaining how to make a balanced detector, and as I find it peculiarly adapted to galena, I give herewith the details.

The assembled detector is shown in Fig. 1. The first thing we must consider is a rotary sliding cup, such as made by the E. I. Co. This is necessary, as every part of the galena must be reached without bending or moving the "cat-whisker" wire.

Next, the two standards A, A, with the bearing screws S, S, are made up; the screws having a hole drilled in the end, as seen.

Then we construct the balance H, as shown. H is drilled and tapped near the lower end for an 8-32 screw, C. The screw is about two inches long and has a ball of lead or brass on one end, the same being soldered, and carries a large nut on the other end. It fits into the hole in H and is the means of adjusting the pressure on the mineral. Turning the screw so the ball approaches the crystal increases the pressure; the nut is used for finer adjustment. H swings like the moving part of a sounder or key, and the pivot should have sharp ends, as it must work easily, or the adjustment will be crude.



The Cat-Whisker of This Detector Is Balanced.

The contact W is a brass wire (No. 22 or 24), with the end R made very sharp and the other end soldered to H; the sharp point being bent, as indicated. Do not bend the wire to reach the different parts of the mineral, but use the slider cup.

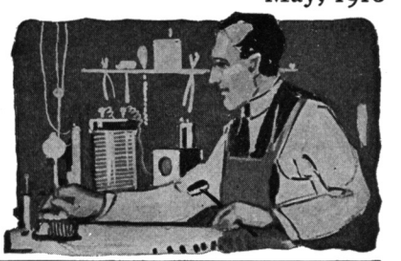
Contributed by
WILLIAM S. SCHMIDT.

A SPARK COIL EXPERIMENT.

An interesting experiment with a spark coil may be performed as follows: Lay a clean sheet of glass on a sheet of tinfoil with a coin in the center of the glass plate. Connect the tinfoil to one secondary coil terminal and the coin to the other. Operate the coil for a few seconds and then carefully remove the coin and breathe on the glass where the coin has been lying. An image of the coin will be seen distinctly on the glass.

Contributed by JASON KILGORE.

THE CONSTRUCTOR

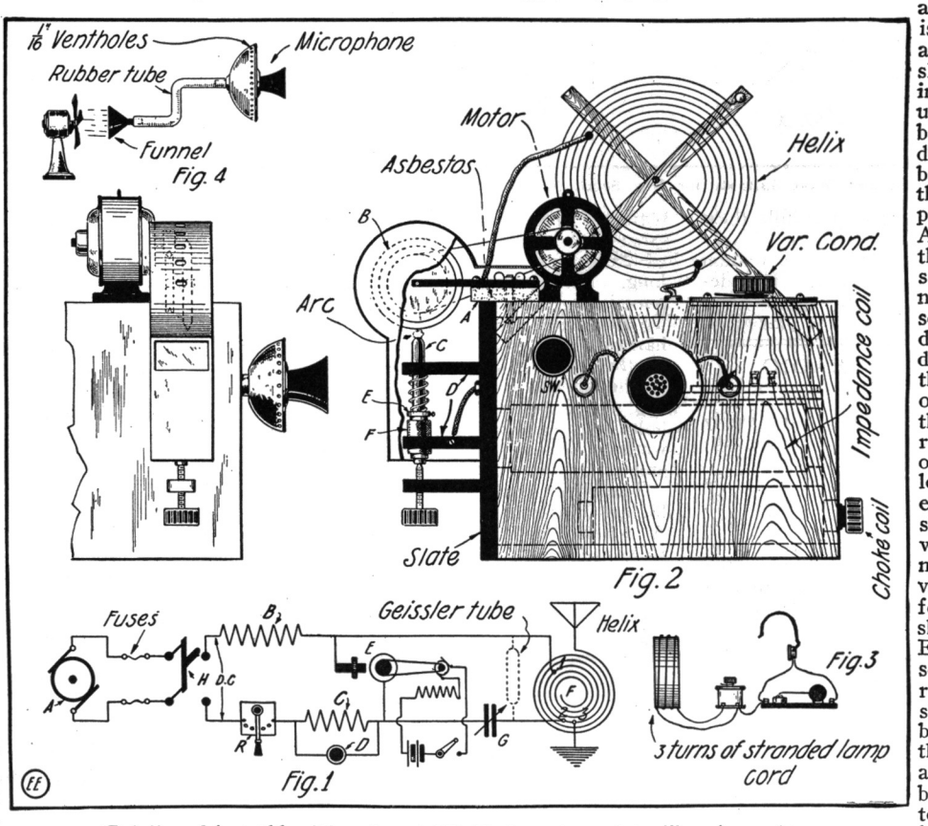


The Use and Construction of a Wireless Telephone Set

By MILTON B. SLEEPER

NOW that wireless telephony is being used commercially, amateurs are becoming more and more interested in this phase of the art. Although the long distance work done at Radio, Va., was not accomplished by the arc system, there are several companies manufacturing arc sets which will easily cover moderate distances. The set described in this article is intended only for experimental work over a few miles, the distance depending mainly upon the current consumption, the cooling characteristics of the transmitter, and the tuning of the set. With a given current a transmitter and set which radiates only a small amount of energy can often be made 400% more efficient by retuning and correct tuning. This factor will be taken up later.

Figure 1 gives a diagram of connections for the instrument. The direct current supply A is 110 volts, although a higher voltage can be used with improved results. The switch H is fitted with 10 ampere fuses to protect the line. To control the current, an adjustable choke coil B is necessary. By pulling the core outward a change is made in the density of the lines of force, which accordingly decreases the impedance of the circuit, and thus allows more current to flow. An impedance coil C is connected in shunt with the microphone D; the voice striking against the diafram of the transmitter, changes the resistance of the carbon grains within. This varies the current flow as the vibrations of the voice change. By adjusting the helix F, the closed radiating circuits are put in resonance. The entire set is contained in a case, Fig. 2. At the right, the handle of the adjustable choke coil protrudes, while the microphone is mounted on the front. At the left is a handle for opening the current supply circuit; on top is the variable condenser handle, rotating arc, and helix.



Details and Assembly of Experimental Radiophone Arc and Auxiliary Apparatus.

Choke Coils.

The core of the larger coil is made of a bundle of straight, annealed iron wires, 10x1 inches in diameter, held together by a single layer of friction tape, wound tightly. The bundle should slide easily in a fiber tube, 1/16 of an inch thick, which insulates the core from the wire. On the tube three layers of No. 14 D.C.C. copper magnet wire are wound. It is well to cover this coil with a layer of tape or Empire cloth. The other coil consists of one layer of No. 12 D.C.C. wire, wound for 10 inches on a cardboard tube 11 inches long and 2 inches in diameter.

Condenser.

In order that the closed circuit may oscillate, it is necessary to have capacity. For this an ordinary receiving condenser of the rotary type, filled with castor or transformer oil is suitable. It is mounted on a small board inside the case with the handle protruding from the top as indicated. This permits a close adjustment of the capacity.

Helix.

The helix is of the usual type, employing copper strip ½ inch wide and 1/32 of an inch thick, wound in slots cut in the wooden cross pieces (or preferably hard rubber). These pieces are fastened to the back of the case. Three spring clips are needed to adjust the inductance; no special design of clips are shown here as too many have already appeared in the various publications and they are sold by all wireless supply houses.

Transmitter.

An ordinary Bell transmitter (microphone) is satisfactory for use with this set. If the current is too great, some difficulty may be experienced from heating. The most satisfactory way to overcome this trouble is to cut out the flat part of the brass shell at the back and fasten to it a piece of rubber tubing. This can be let out through the back of the case to a fan. In the set used for experiments, a funnel was put in the tube to collect the wind created by the fan. Holes must be bored in the shell to let out the air. No disturbance should reach the arc, however, as a draft of air makes the spark irregular (see Fig. 4).

The Arc.

Figure 2 shows the construction of the arc. To protect the eyes from the blinding light a metal hood is fastened over the arc. In front of the carbon a small piece of smoked glass is fitted to enable the operator to see when he has obtained the best adjustment. The hood is two inches wide and of the shape shown in the drawing. Slots cut in the upper part allow the belt to run to the disc. The hard rubber piece, A, holds the hood from slipping off. This piece, A, is pivoted to allow the wheel, B, to be swung aside when a new carbon is inserted. The copper disc, B, is 3 inches in diameter and 3/8 inch thick. It is beveled on the edges so that the two faces are at right angles to each other. A wooden pulley, 2 inches in diameter, mounted on the shaft with the copper wheel, is belted to the motor. The sectional view of the bearing for the carbon rod shows a brass sleeve, E, fitted with a small set screw. As the rod is adjusted, the sleeve E slides in the brass tube F. All three of the uprights are made of heavy brass stock. As a protection against the heat, slate or other heat resisting material must be used for the left hand end of the case. For connections to the arc, one wire is soldered to the middle upright. The other is fastened to one of the arms on which the copper disc is pivoted.

The motor is small, as little power is needed to turn the wheel. Some form of rheostat should be used to regulate its speed. A thick rubber band makes a good belt which will not slip on the pulleys.

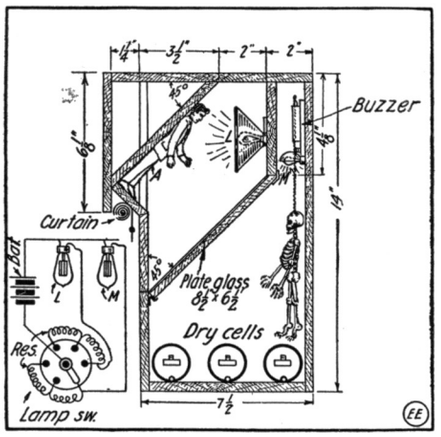
Switch.

It is necessary to have a main line switch with fuses to control the current supply. The best method is to mount the switch at the back of the case, with a rod passing

(Continued on page 65)

A MINIATURE PEPPER'S GHOST ILLUSION.

Probably many readers have seen a "Pepper's Ghost" illusion at some amusement place. As there shown, the audience is generally seated in a dark room at the end of which is a stage with black



Details for Constructing a Miniature Pepper's Ghost for Parlor Amusement.

hangings. One of the audience is invited onto the stage, where he is placed in an upright open coffin. A white shroud is drawn over his body and his clothes and flesh (apparenly) gradually fade away until nothing but his skeleton remains, which immediately begins to dance a horribly rattling jig. The skeleton then fades away and the person is restored again.

The explanation is thus: Between the audience and the coffin is a sheet of transparent glass, inclined at an angle so as to reflect objects located behind the scenes, but the glass is to be so clear that it will be invisible to the audience and the man in the coffin. At the beginning the stage is lighted only from behind the glass. Hence the coffin and its occupant are seen through the glass very plainly. The lights in front of the glass are now raised very gradually as those behind the glass are turned down until it is dark there. The perfectly black surface behind the glass now acts like the silver backing of a mirror, and the object upon which the light is now turned, in this case the skeleton, is reflected in the glass, appearing to the audience as if really occupying the stage.

The model, which requires no skill except that of carpentry, is constructed as shown in the drawings.

The cabinet containing the stage should measure about 14x7x7½ inches; these are outside dimensions. The box need not be made of any particular kind of wood, as the entire interior, with the exception of the glass, figures and lights, should be colored dull black. This can well be done by painting with a solution of lampblack in turpentine. If everything is not black, especially the joints and the background near A, the illusion will be spoiled.

The glass should be the clearest kind and must be thoroughly cleaned. Its edges should nowhere be visible and it should be free from scratches and imperfections. The figure A should be a doll about 4 inches high, dressed in brilliant, light-colored garments. The skeleton is made of papier-mâché and can be bought at Japanese novelty stores. It should preferably be one with arms suspended by small spiral springs, giving a limp, loose-jointed effect. The method of causing the skeleton to dance is shown in the illustration. The figure is hung from the neck by a blackened stiff wire, attached to the hammer of an electric bell from which the gong has been removed. When the bell works he will kick against the rear wall and wave his arms up and down, thus giving as realistic a dance as anyone could expect from a skeleton.

The lights, L and M, should be miniature electric lamps, which can be run by four volts. They should give a fairly strong light, especially L, which should have a conical tin reflector to increase its brilliancy and prevent its being reflected in the glass.

Since the stage should be some distance from the audience, to aid the illusion, the angle of the glass and the inclination of the doll, A, has to be so designed that if the stage is placed on the mantel or other high shelf the image A will appear upright to an observer sitting in a chair some distance away, within the limits of an ordinary room. If it is desired to place the box lower down, other angles for the image will be found necessary, but the proper tilt can be found readily by a little experimenting.

The electrical connections are so simple that they are not shown in the cabinet drawings. All that is necessary is a two-point switch, by which either L or M can be placed in a circuit with the battery and a push button in circuit with the bell and its battery.

If a gradual transformation is desired, a special rheostat could be used so that as one light becomes dimmed the other increases in brilliancy by the variation of some resistance coils, as the wiring diagram shows.

When the model is carefully operated it will undoubtedly amaze many of your friends, and it will prove an interesting electric novelty for evening entertainments.

HOW TO MAKE AN ELECTRIC CLOCK.

A clock which runs for weeks, yes, even months, is a thing which every professor should have. But to own one, however, one need not be a professor. Any experimenter can make one similar to the design here offered. Instructions for making such a timepiece are given below.

It consists principally of a pendulum so arranged as to control an electro-magnetic device, to give it energy with which to carry it through its successive swings.

This is accomplished by having a cross-beam attached near the top of the pendulum, which latter is suspended on a knife edge to reduce friction to a minimum. When the pendulum swings to the left the armature of the electro-magnet is pushed up by the screw at the left end of the arm until contact is made between the spring 3, attached to the upper side of the armature, and the contact screw above it.

This will cause the current from the battery to flow through the electro-magnet, thus pulling the armature down, which in turn gives the pendulum a push over to the other side and breaks the current between contacts 2 and 3. The pendulum will thus be made to swing to the right, then to the left, with this process repeated as long as there is any energy left in the battery, or at least enough to pull down the armature.

Exact dimensions for building are not given, as they will vary with the size of the clock. The size of the parts, however (excluding the pendulum), have no direct bearing upon the operating, but let it be understood that for a large clock a larger magnet will be necessary than for a small one.

In building this chronometer-driving device use platinum or platinum-iridium contacts, if possible, as these will not burn out as fast as others. Also, do not forget to glue a piece of lead-foil—commonly known as tin-foil—on the face of each pole piece. It should have a diameter of about one-half that of the pole face, as this will prevent the armature from sticking to the poles if it comes into contact with them, for there is almost always a little residual magnetism in the iron after the current stops flowing. As to the battery, use a storage battery if you have one. Dry cells will run down in a rather short time if used continuously. Do not try to use gravity or sal-ammoniac cells, for they are not satisfactory.

Attachment of the clock-work will not be dealt with in this article. Every clock must be attached as the builder sees fit. There are so many different makes and types of clocks that each must be rigged up in its own way.

After setting up the device is to be adjusted as follows: The nuts 5 and 6 are to be so placed that the stem 7 will be vertical. Use the larger nut 5 for rough adjustment and the smaller one 6 for finer adjusting. The point X should be placed so as to be directly below the point Y of the pendulum when the latter is vertical.

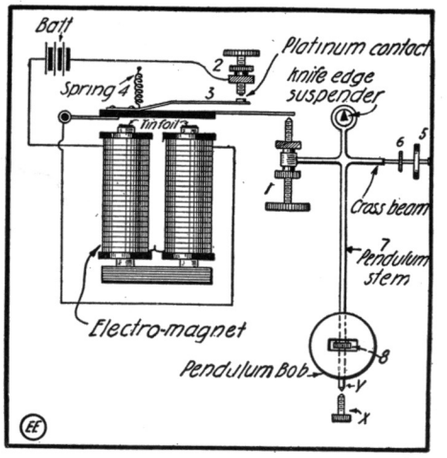
The spring 4 should be of such precise tension that it will just hold the armature in such a position that the spring 3 will be about 1-16 inch below the contact point on screw 2. It should allow free downward motion of the armature when pulled down by the magnets.

Have the armature about 1-16 inch, but not more than 3-32 inch above the pole faces of the electro-magnet and parallel to them when at rest.

When this has been done, adjust screw 1 so that it will cause the contact between 2 and 3 to be made just at the end of its left swing. Then tighten the screws 1 and 2 to prevent them from getting out of adjustment when tightening the extra nuts on them.

Now all is ready to set the clock going. If it goes too fast lengthen the pendulum. This is done by lowering the bob (turning the nut 8, in its center, to the left). Should the clock go too slow the reverse operation will remedy the trouble.

To the writer's knowledge, three such clocks have been made, one by himself and two by friends, all of which worked well after being properly adjusted and kept time correctly for several months at a stretch. It is not a novelty, but a practical device.



Simple Design of Electric Clock Which Will Undoubtedly Interest All Electrical Dabblers. It Can Be Made at Very Small Cost.

This mechanism is not used commercially to any great extent, for there are other better but more complicated means of electrically operating clocks.

Contributed by KARL KIRSCH.

THE ELECTRO-MAGNETIC NATURE OF LIGHT WAVES.

An effect not generally known by the young electrical or scientific student is that light waves manifest an electro-magnetic quality, and which characteristic can be demonstrated in quite a marked manner by means of the apparatus hereinafter mentioned.

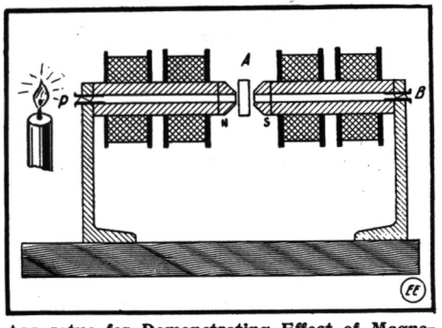
To begin with, light is affected by the magnetic field in several ways, one of the most distinct and interesting actions is that known as the Faraday effect. Referring to our illustration, which indicates the use of a bipolar electro-magnet, we have at A a block of transparent solid substance, or it may be a glass tank containing a transparent liquid. N and S are the poles of a powerful electro-magnet which are pierced or drilled through with a small hole, so that it is possible to look straight through the axial center and likewise through the transparent substance at A. A pair of Nicol prisms, P and B, are placed in the center of the pierced holes, one to act as a polarizer and the other as an analyzer. A source of light is placed in front of P so that it can be observed through the poles from the position B.

The Nicol prism, it may be remarked, is made by dividing a crystal of calcite and cementing the two portions together with Canada balsam in such a manner that the more refracted, i. e., the ordinary ray, meets the surface of the balsam at an angle so obtuse as to be totally reflected within the prism, while the extraordinary ray passes through and thus the crystal transmits a beam of plane polarized light. The crystal so prepared is one of the most common and best forms of polarizer or analyzer known.

The analyzer B is rotated until it extinguishes the light. If now the current of the electro-magnet is switched on the field of view through B will suddenly brighten so that the rays which were completely stopped or cut off by B before any magnetic field was established across A are now able, at any rate partially, to pass through the Nicol prism. The latter is then rotated to a new position, where the light is again completely cut off so that the rays are still polarized, but the plane of polarization has been turned. This phenomenon of rotation of the plane of polarization is called rotatory polarization.

Another remarkable magnetic effect on a beam of light is that known as the Kerr effect. This was discovered by Kerr in 1887. He found that when a plane of polarized light is reflected at the polished pole of a strong electro-magnet of the type aforementioned that reflected light is no longer plane polarized. It is found that the vibrations have become elliptical, instead of being in straight lines, owing to the reflection at the magnetized surface.

Thus we see that without a doubt there



Apparatus for Demonstrating Effect of Magnetism on Light.

is an intimate connection between magnetism and light, which coincides with the calculations by Clerk Maxwell, which prove that electro-magnetic waves in air and light travel at the same rate of speed. It has come to be considered to-day that what we term white light is nothing more or less than extremely short, transverse electro-magnetic waves propagated through the luminous ether which is supposed to fill all space not already occupied by any other matter, as well as the interplanetary chasms, according to modern scientific views.

AN AUTOMATIC LIGHTNING SWITCH.

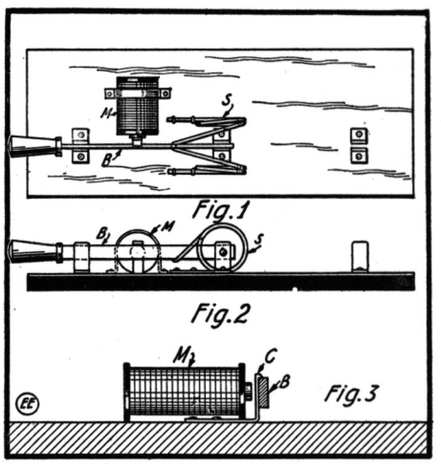
Electricity is now one of the most obedient servants of man; yet, given a chance, it will deal a deathly blow. For instance, let us consider the lightning switch in the amateur's wireless set.

The lightning will pass peacefully to the ground if the switch is properly closed; but leave it connected to the apparatus, and how does it behave? Zowie!!

To automatically take care of the human factor begetting carelessness and forgetfulness, I have designed a novel apparatus; sketches herewith. It will ground the aerial in case it is left connected to the set when a lightning storm comes up.

The apparatus consists of a coherer, a relay and a special lightning switch.

The latter is shown at Fig. 1, top view. It consists of the regular 600-volt 100-ampere knife switch, with the addition of a spring S, acting on the blade B, which is



Release Magnet Coil Fitted to Lightning Switch.

held in position by the catch C. At Fig. 2 is shown the side view, while Fig. 3 gives the details of the catch, magnet and blade. The lettering is the same in all three sketches.

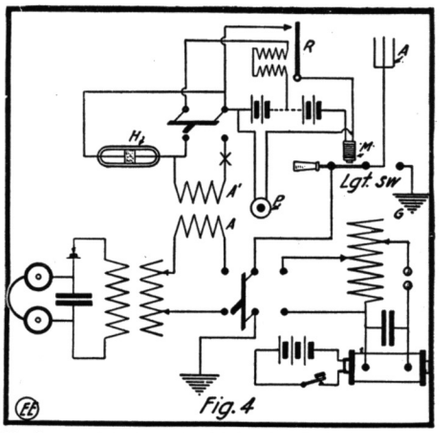
The coherer may be of any type using metal filings, and the relay should preferably be of the polarized type, but a high-resistance pony relay will do the work if well adjusted.

The apparatus is connected as shown in Fig. 4, and the operation will be as follows:

Suppose you leave the lightning switch thrown as shown in Fig. 4, and a thunder storm arises. The first preliminary static discharge will act on coil A^1, consisting of about 10 turns, by reason of its being inductively coupled to coil A, consisting of a like number of turns. A minute spark gap should be placed at X to keep the regular signals from actuating it.

This induced current will cause the coherer to lose its high resistance and the relay R will operate, closing the circuit through the magnet M. The catch C will be attracted and, releasing the blade, will allow it to swing over to the ground jaw, and your set is safe from the main lightning discharges.

A switch is cut in to open the circuit in case high power is used and to prevent the relay from operating, due to the effects of



Hook-up of Automatic Lightning Switch in Radio Station Circuits.

the transmitting set. A push button P is also wired in, so that by pressing it the switch can be thrown to the grounding position when suddenly called away from the set. Contributed by T. W. B.

IRON LOSSES AT HIGH FREQUENCIES.

Among the papers read at the recent British Association meeting was one by N. W. McLachlan, B.Sc. Eng., entitled "The Heating of Iron When Magnetized at Very High Frequencies." The paper described experiments illustrating the heat produced when iron is magnetized by very high frequency alternating currents, e. g., 2×10^6 to 5×10^6 periods per second.

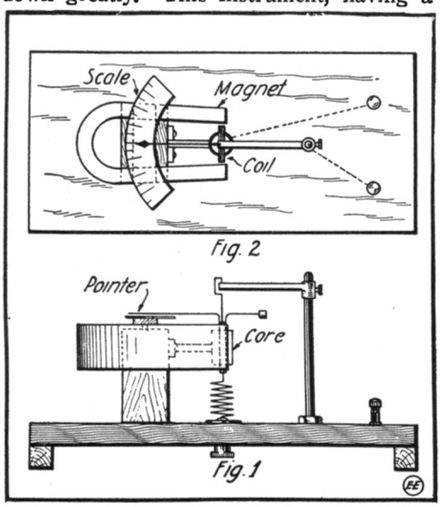
The magnetizing current was obtained by using a Poulsen arc generator connected across the city mains (240 volts). In order to demonstrate the extent of the losses, a magnetic heater or boiler, consisting of a solenoid wound on a glass tube containing water and a number of iron strips or wires, was inserted in the shunt circuit of the generator. A short time after the shunt circuit was closed the water began to boil.

An experiment was also arranged to show the variation in permeability of iron with variation in temperature. A ring of Lohys (mild steel) was insulated with asbestos and wound with a number of turns of copper wire. This was connected in the shunt circuit of the generator. By passing a large current through the windings of the ring, thereby obtaining a strong magnetizing force, the magnetization losses were such that a rapid rise in temperature was produced, causing the iron to attain a bright red heat.

In the discussion following the reading of the paper, Professor Gisbert Kapp drew attention to the fact that the losses observed were extremely high compared with what was encountered at ordinary frequencies. It had long been a puzzle to those familiar with ordinary alternating current work as to how it was possible, in view of hysteresis and skin effects, to use in wireless work frequencies of a quarter of a million or so in circuits containing iron. They were often told by wireless engineers that the usual rules did not apply at high frequencies, but apparently from the author's figures this was incorrect. Professor Howe said that the discrepancy pointed out by Professor Kapp arose because the formula quoted by the author gave simply the skin losses. As the frequency rose the flux was, in fact, more and more confined to the skin, so that less and less iron was really involved in the phenomenon.

THE CONSTRUCTION OF A SENSITIVE GALVANOMETER.

The galvanometer herein described is of the moving coil type and is very sensitive and accurate. In the moving magnet type the size of the magnets is limited and thereby the sensitiveness of the instrument is cut down greatly. This instrument, having a



Top and Side Views of Galvanometer.

moving coil, enables the constructor to use a large and very powerful electro-magnet, but the coil must be small to assure sensitiveness and quick action. In order to meet these requirements a wire of extremely small gauge is required.

In the large commercial type instruments jewel bearings are used to support this coil, but these are beyond the reach of most experimenters. The instrument herein described uses frictionless bearings and the armature is returned to its normal position by means of a small spring placed underneath the coil, instead of by a hairspring, as in the commercial forms of galvanometers. This galvanometer will be practically dead beat, due to a certain extent to the iron core being mounted in the center of the coil and the high density of the lines of force between the poles.

To proceed with the construction: The first necessity is a permanent magnet of the ordinary horseshoe type. This is shown in the sketch and it should be bent on the flat instead of edgewise, as most magnets are. This magnet is mounted on a small wooden block, as shown in the drawing. This block also serves as a support for the core and scale. The core is a small piece of cast iron and serves to concentrate the lines of force between the poles of the magnet.

The core is drilled radially and the hole is tapped for an 8-32 thread. A small piece of brass rod is screwed into this hole, and the other end of the rod is fitted tightly into a hole in the wood block. The core should now be exactly centered between the pole-pieces, as shown in the illustration. The magnet itself should be given a coat of enamel and then placed into position shown in the drawing and clamped down with a strip of brass, by means of a screw passing through the brass and into the block of wood. Now to turn to the construction of the coil. The form for this coil is made on a block of wood about ¾ inch square. A few layers of paper are wrapped on this form, which should be slightly tapered to facilitate the removal of the coil after winding. Two strips of paper should be wound parallel over this paper to form a slot $\frac{3}{16}$ inch wide and ¼ inch deep. Threads should be laid across this slot before winding.

The slot is wound full of No. 40 enameled wire in close, even layers, placing as much wire as possible on the coil. An 8-inch length of wire should be left at both ends and the threads tied to hold the winding together. The coil is removed from the form and wrapped with narrow strips of friction tape. The ends of the winding should then be brought out at opposite sides of the square coil. It should be given a couple of good coats of shellac and allowed to dry. A sketch showing how the form will appear before winding is shown at Fig. 3.

The support for the coil may be made by winding a No. 18 copper wire once around the coil and twisting together where one of the wires from the coil comes out. This piece of heavy wire should have one end about 2 inches long, and this is bent to the form depicted in drawing. The end of the wire is sharpened to a point and rests in a small depression made in the brass arm which slides up and down the standard, and this is permanently fastened to the small copper tube, which has a set-screw to clamp it in any position. The depression in which the copper wire rests has a small drop of mercury placed therein to assure a good electrical connection. The pointer is placed in position by running it underneath this wire, where it is fastened to the coil proper. The pointer can be made of a piece of brass wire flattened on one end and touched up with a little black enamel. On the opposite end of the pointer is mounted a counterpoise weight. This can be made easily by winding the wire in a close spiral and, after the instrument is assembled, clipping off a short length at a time until the armature

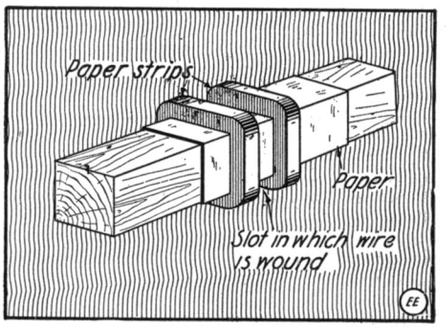


Fig. 3. How Form Is Constructed for Winding Galvanometer Coil.

balances centrally on its pivot. The needle can be fastened by means of fine silk thread and shellacked to hold it stiffly in place. The next consideration is the scale, which is mounted on the magnet. It consists of a piece of zinc cut to the shape shown. A scale made of smooth white paper is calibrated in degrees with the zero at the center. Divisions on the scale may be made to suit the fancy of the constructor, but 10 to the inch is usually sufficient.

The bottom lead wire from the coil is twisted into a spiral and soldered to a copper washer. A bolt is put through the center of the washer into the base and one connection is made to the screw. In adjusting the instrument, if the pointer does not rest on zero it is merely necessary to turn this washer a few fractions of an inch in the proper direction until the pointer reaches the zero mark, and clamp it there by means of the nut. It would be advisable to make the base-board large enough so that a glass bell jar can be placed over the galvanometer to protect it from dust and moisture.

Very few measurements have been given, as a great deal depends upon the size of the magnet available and odd pieces of scrap at the constructor's disposal. The details can be varied greatly if reasonable care is exercised to get the parts in the proper proportion. The instrument is now complete and may be tested. It is well to remember that this galvanometer operates on very small currents, and powerful currents should not be used or the instrument will be burned out. When powerful currents are to be measured some high resistance wire should be placed in series. A good method of testing the sensitiveness of this galvanometer is to take an ordinary half-dollar and connect one wire to it and lay a piece of flannel soaked in salt water on top of the coin. Now touch this flannel with a copper wire connected to the other terminal of the galvanometer. A deflection of at least ½ inch should be obtained, which indicates that the instrument is in excellent working condition.

SCALE FOR RADIO EXPERIMENTAL APPARATUS.

After trying many ways of scaling my apparatus, ranging from pasting paper scales on the hard rubber front to screwing on the rather expensive scales as offered for sale, I hit upon this idea, which has proved more substantial and attractive than any other method. It may be used equally well on hard rubber, bakelite or black fiber. The scale as desired is made by taking a pair of dividers and scratching the scale in the rubber, etc., using a protractor to mark off the degrees. When the scale has been scratched white lead paint is rubbed into the marks, which, when dry, show out exceedingly well against the black background.

Contributed by HAROLD O. BIXBY.

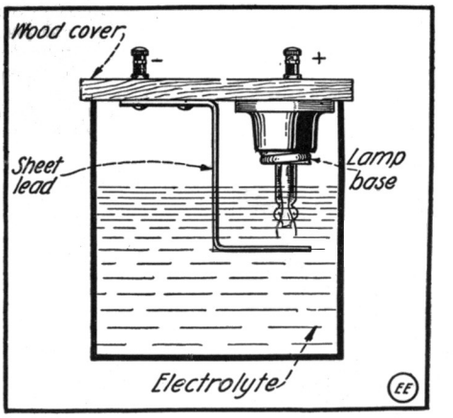
CHEAP AND EASILY MADE ELECTROLYTIC INTERRUPTER.

Procure an old, standard size lamp bulb and break away the glass from around the base, leaving the projecting glass support for the filaments as shown. Unsolder the filaments from the two platinum lead wires as shown. Screw a receptacle on a piece of dry board, which serves as a cover for the jar (a common, small battery jar), Into the receptacle screw the base prepared as above. On the opposite side of the cover provide a terminal for the receptacle, which should be short-circuited on itself.

Procure a piece of sheet lead 2x8 inches, bending and screwing it on the cover about as shown and provide a terminal post. A space of ½ to ¾ inch should be left between lead plate and platinum wires.

Use dilute sulphuric acid for electrolyte, which should stand in the jar about the height shown in sketch.

This interrupter should be connected in



Home-Made Electrolytic Interrupter.

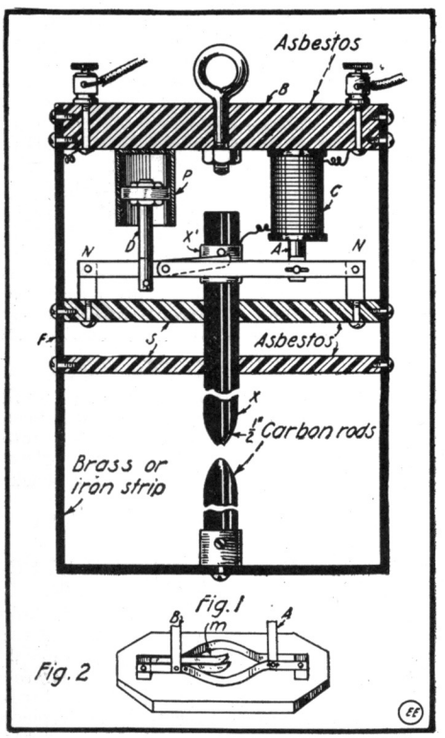
series with coil, fuse blocks, etc., as usual. Connect positive wire to receptacle terminal if direct current is used, but if alternating current is used it will make no difference.

Contributed by CLYDE G. SYKES.

AN AUTOMATIC ARC LIGHT.

By Alphonse Poincaré.

The writer takes pleasure in offering some suggestions for making an automatic arc light to the experimenters who are interested in this piece of apparatus. As most instructions are usually changed to accommodate the various materials at hand in the young electrician's workshop, the writer will not go into great detail, but will merely describe the different materials to be used in the make-up of the lamp.



A Home-Made Electric Arc Lamp of Simple Design.

It may be mounted on a piece of hardwood or, better still, a piece of asbestos board about ¾ inch thick and measuring 6x3 inches. This is indicated at B in the drawing. A strip of brass or heavy strap iron ½ inch wide and ⅛ inch thick is bent to form the frame F. This is fastened to the base by means of some brass screws.

Two supports S, made of asbestos board ⅜ inch thick, are fastened inside of this frame by means of screws. These pieces have holes drilled in their center to admit the upper carbon X. To regulate the arc you will need a solenoid C and a dash-pot. The solenoid consists of a brass tube ⅜ inch interior diameter, wound with about a half pound of No. 18 D.C.C. magnet wire. The exact amount of wire to be used must be determined by experimenting. The dash-pot consists of a short piece of brass tubing ¾ inch in diameter, with a plunger P arranged to slide inside same.

The lever to control the upper carbon can be easily understood from Fig. 2. This consists of brass strips ⅜ inch wide and ⅛ inch thick, bent as shown and pivoted to the two brass blocks N N.

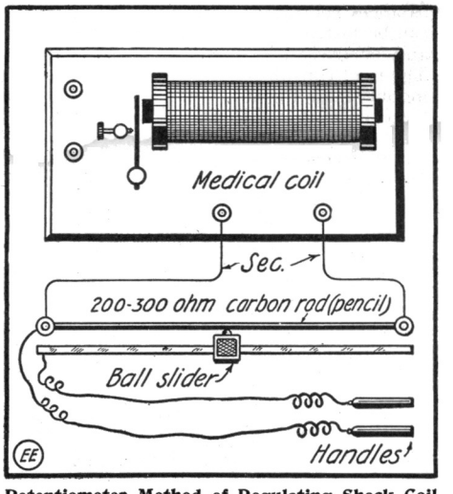
A holder for the lower carbon is made from a piece of brass tubing fastened to the middle of the lower strap F, and should have an internal diameter sufficient to accommodate a standard-size electric light carbon. This is equipped with a set screw to clamp the carbon into place. A short piece of tubing X_1, the same size, is used to form a connection for the upper carbon. Two set-screws are used in this tube, one on either side. These set-screws fit into depressions in the brass strips, and by this means the lever can raise the carbons. The drawing is sufficiently clear to show the series wiring of the arc lamp and any other details not given in the description.

It may be of interest to state that the iron core A of the solenoid is pivoted to the brass levers, while the rod connecting it to the plunger of the dash-pot has a slot cut in it which fits over the brass lever, and a pin is placed through the holes in the end as indicated, so that any movement of the lever is communicated directly to the plunger and dash-pot. The operation of the arc lamp is as follows: Under normal conditions the carbon rods are in contact, but as soon as the current energizes the solenoid C it attracts the iron core A. By means of the system of levers it separates the rods, thereby starting the arc. It will be necessary to experiment with the amount of wire on the solenoid so that the arc will not jump and sputter; the action should be smooth. The dash-pot should be greased with vaseline to make it a more or less tight fit and thus insure the smooth working of the piston. If the arc is supplied with the direct current circuit, connect the positive line wire to the binding post at the right; but if alternating current is used with the arc it makes no difference how the connections are made. It will be necessary to insert ballast in the circuit, consisting of either wire resistance or a water rheostat, to further insure the proper operation of the lamp.

This lamp is built similarly to the commercial types and is suitable for use out of doors. When used thus it should have the working parts protected by a tin case, and a glass globe may be put over the lower half. The arc is self-controlled, for when the carbon burns away the resistance is increased and the current falls; this weakens the solenoid C and allows the core A to slide out a fraction of an inch, thereby shortening the arc. This action will continue until the rods will no longer make contact and it will be necessary to slide them a short distance through the upper tube to put the arc into working condition again. This device should be particularly interesting to those who experiment along this line.

A REGULATOR FOR MEDICAL COILS.

It often occurs that one happens to have a small induction coil such as used for



Potentiometer Method of Regulating Shock Coil Secondary Current.

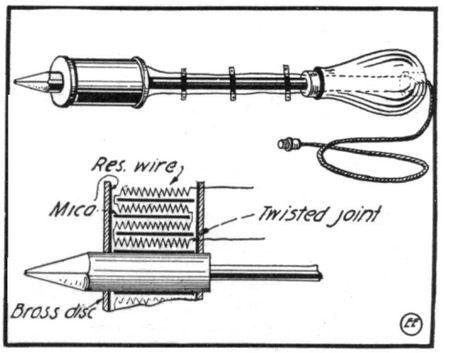
electro-medical purposes and on which the regulator possibly does not give as fine a graduation of the current as desired; or, in some cases, the coil may be of the "solid" type, without any attached regulator at all. In such cases it will be found efficacious in the regulation of the secondary current supplied to the handles, etc., to employ a potentiometer such as the carbon rod type (having 200 to 300 resistance), shunted across the secondary leads as diagram clearly shows. In this way it is possible to obtain a very small current at the handles when desired and moreover the current is finely adjustable.

Contributed by
AN EXPERIMENTER.

AN ELECTRICALLY HEATED SOLDERING IRON.

Herewith is described an electrically heated soldering iron which I am sure will become very popular with the experimenter, who so often has a wire to solder and hasn't the time to start his blow torch and heat his iron, all of which takes time. I have been using this iron for some time with the best of results.

Take a common soldering iron, clean it



A Useful Electrically Heated Soldering Iron.

up well by filing to a good point, then tin it thoroughly. Procure several sheets of thin mica (about .002 inch in thickness) and wrap it around the iron until you have five or six layers on. Obtain 20 feet of No. 26 nichrome resistance wire and two feet of No. 16 asbestos-insulated copper wire.

Start wrapping the resistance wire around the iron, beginning at the end nearest the handle. Place one layer on, then one layer of mica over this. Now wind another layer of wire over this, in the reverse direction. Continue in this way till you have all the wire on. Care should be taken that the windings are separate from one another. A small piece of asbestos wick can be placed between the turns, but this is not necessary if you wind the wire on tight.

Cut the length of asbestos-insulated wire in half and fasten one piece to each terminal of the coil. These wires are run up through the handle. Bore two holes in the wooden handle, one opposite the other, for the purpose. To the ends of the wires fasten some flexible lamp cords, and to this connect an attachment plug. Tie a knot to handle to keep cord from untwisting.

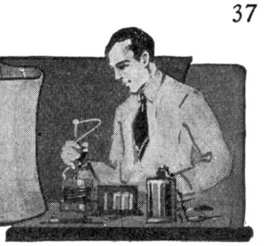
Test the iron to see if it is too hot or not hot enough by turning on the current for several minutes. If the iron gets too hot the resistance is not sufficient, so add more resistance wire. If the iron does not heat up enough there is too much resistance; therefore take off some wire. Perform these changes before you encase the coil.

A two-pound iron will be found best to use for this purpose. This iron can be used on 110 volts alternating current or direct current for the data here given.

Contributed by GEORGE MILLER.

When using the telephone in a noisy place, holding the hand over the transmitter will reduce the noise to a certain extent. To call "central" move the hook up and down slowly, not rapidly.

HOW TO MAKE IT

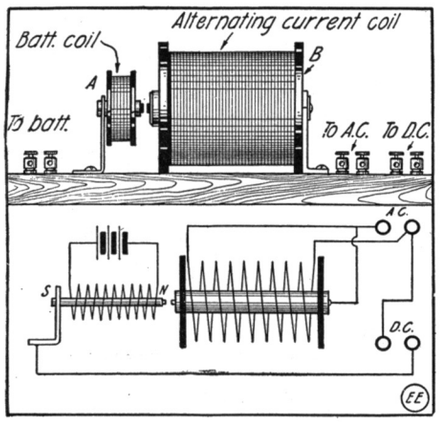


This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

A. C. TO D. C. MAGNETIC RECTIFIER.

Referring to the accompanying illustration, the small coil A is connected to a battery of dry cells, which magnetizes its core producing, say, an N pole in the end nearest the coil B, which is connected directly to the alternating current line. This coil contains many turns of fine wire. From the preceding data it may be noted that while the battery coil A has permanent magnetic poles, the poles of the B coil are constantly changing. Whenever the B coil produces an S pole adjacent to the battery coil, coil A is attracted, thus closing the main circuit and allowing a positive current to flow through binding posts 1 and 2 (see diagram). As soon as the polarity changes the coil A is repelled, thus breaking the current and allowing



Magnetic Type of Polarized Rectifier.

only a positive current to flow, as the reversals are cut off by the repulsions.

Contributed by DAVID KUSKIN.

Iron or steel may be cleaned of rust by the use of the following: 100 parts *Stannic Chloride* dissolved in 1,000 parts *Water*. Add to a solution containing 2 parts *Tartaric Acid* dissolved in 1,000 parts *Water*. Add to the mixture 20 cubic centimeters *Indigo Solution* diluted with 2,000 parts of *Water*. Clean the metal parts of all grease, apply the solution to the stained portions for a few seconds, rub clean with a moist cloth, then with a dry cloth, and if desired then use any good metal polish.

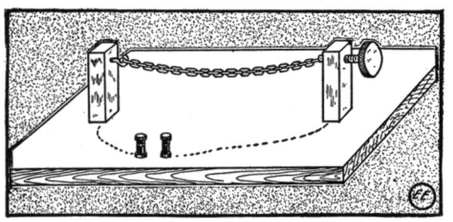
FILTERING QUICKSILVER.

Quicksilver or mercury is frequently used in connection with electrical experiments and for many purposes is required to be fairly pure. If contaminated by contact with other metals, the simplest method of purification is to filter under pressure through chamois skin. The illustration shows a convenient appliance for dealing with such small quantities as the average experimenter is likely to use. In the illustration, A is the tube from a glass syringe, with a few inches of thick-walled India rubber tube ("pressure tubing") B, tied

SECOND PRIZE $2.00

A "CHAIN" RHEOSTAT.

Herewith is a diagram of a novel form of rheostat. The only materials necessary in the construction of this rheostat are a common chain six inches long, two binding posts, a base eight inches long by two and a half wide and a screw-binding post to tighten the chain. By tightening the chain, more current will flow and vice versa. A little study of the diagram will enable anyone to make it without trouble.

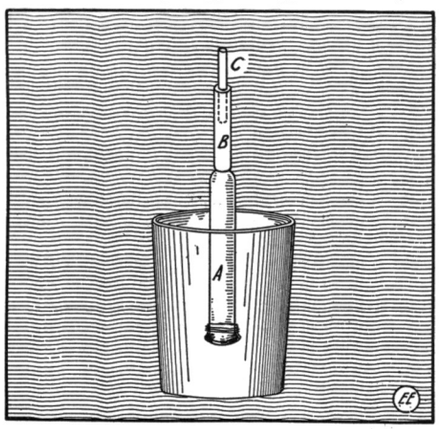


Battery Rheostat Made From Piece of Chain.

Contributed by HOMER NIXON.

firmly into position at the small end. Part of the glass stem C forming the piston or plunger may be used for temporarily closing the end of this tube.

With the glass plug in position, pour the soiled mercury into the tube, not more than half filling it. Then tie a piece of wash leather (chamois) over the wide end of A with a strong thread and invert over a tumbler. If the glass plug is withdrawn and the rubber tube connected to a cycle pump one or two strokes of the latter will compress the air sufficiently to force the metal through the pores of the leather, the dross being left behind. It is convenient to include a Dunlop or check valve between the pump and the rubber connection to prevent the air escaping. In this case once sufficient pressure has been obtained with the pump, the apparatus may be



Simple Method of Filtering Quicksilver.

left to itself until all the mercury has passed through the leather.

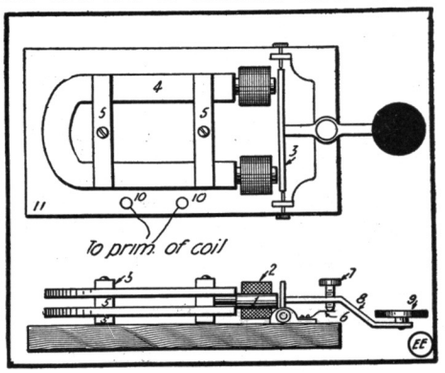
Contributed by H. J. GRAY.

THIRD PRIZE $1.00

MAGNETO KEY TO SAVE BATTERIES.

As I wanted to dispense with the cost of dry cells in my wireless outfit, I constructed this magneto key which has served me faithfully. It is an ideal combination of a magneto and a key, having operated the 1½ inch coil of my transmitting set for six months and is still in good condition.

This magneto key operates on the principle of induction and generates currents sufficiently powerful to work a polarized bell over a line several miles long. The key is made by clamping two 6 inch or 7 inch horseshoe magnets upon opposite sides of two soft iron polar extension pieces 1½ inches in diameter by 1¾ inches long and projecting beyond the poles of the magnets. Each extension piece has a bobbin 2, 1 inch long by 1 inch in diameter, wound full with No. 36 enameled wire. These



This Magneto Key Will Reduce Your Battery Bill.

bobbins having a combined resistance of 200 ohms. are wound and connected like the spools of an ordinary electro-magnet.

An armature 3, ¼ inch thick, a little longer than the width of the extremities of the magnet and 1 inch wide, is situated in front of the poles of the magnet. This is pivoted at its lower edge and provided with a key lever by which it may be drawn away from the poles of the magnet. The armature is thrown back into contact with the magnet by a stiff spring under the key lever.

In this apparatus like poles of the magnets must oppose each other. The clamping pieces and screws should be of non-magnetic material.

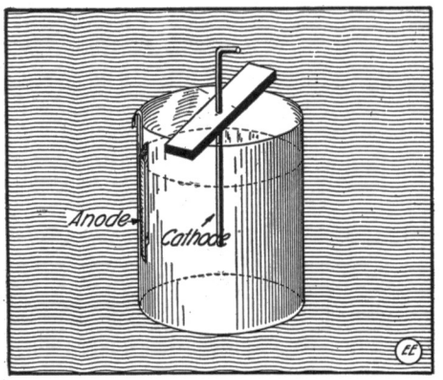
The armature 3, when applied to the polar extensions, becomes a magnet by induction and by its reaction upon the magnet neutralizes the power of the same and produces nearly the same result as withdrawing the magnet from the bobbin. When the armature is withdrawn suddenly from the magnet, the effect upon the wire of the bobbins is the same as would be produced by introducing them into the field of the magnet; thus a powerful current is generated.

The accompanying illustration will explain the apparatus more fully.

Contributed by HARRY FUCHS.

MAKING METALLIC "TREES" BY ELECTROLYSIS.

Every chemical student is familiar with the "trees" of silver and lead obtained by immersing strips of zinc in solutions con-



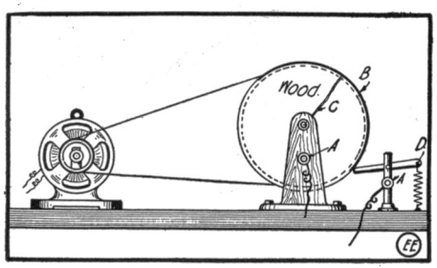
Forming Metallic Trees by Electrolysis.

taining salts of these metals. Very few metals, however, will yield such designs by this means. But if a feeble electric current is sent through an electrolytic cell, consisting of a small cathode and a large anode in a solution of a salt of the same metal, very beautiful trees may be obtained. A single Daniell cell will give sufficient current for the purpose. The cathode should be made from stout wire, supported by means of a piece of wood as shown, and should be varnished to within 1-16 inch of the end. A silver wire in a solution of nitrate of silver gives the usual form of tree; so does lead in lead acetate, provided the exposed tip of the cathode is not tarnished by a film of oxide. The cadmium tree produced in this way is quite characteristic, the branches being particularly fine. The zinc tree formed in chloride of zinc has also very fine branches. Even copper will yield such a figure by using a copper wire and a solution of cupric chloride.

Contributed by H. J. GRAY.

A FLASHER FOR SMALL BATTERY LAMPS.

The accompanying illustration shows an easy way of making an excellent electric flasher for small battery lamps. This will be interesting to those who like simple designs. The disk is made of wood and can be of any diameter (4 or 5 inches) and 1¼ inches thick. There are two grooves turned in the disk, one for a ¼-inch belt and one for the ¼-inch brass strip, which extends half way around the disk. A is a binding post, B a strip of brass, C wire connecting drum strip with brass bushing in disk, which runs on a



Easily Made Rotary Flasher for Battery Lamps.

metal shaft so that the current will be carried through the device. D is a spring brass lever kept in contact with the disk B by means of a small spring. By closely following the illustration you can make it in a short time. My own was used for flashing small bulbs under a Christmas tree. It was operated by a 4-volt motor controlled by a 10-ohm rheostat.

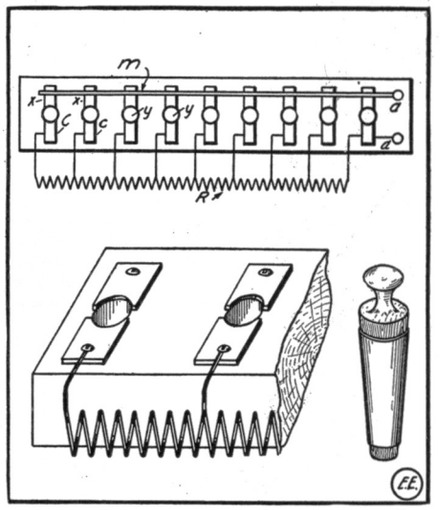
Contributed by SAMUEL R. CHURCH.

A SIMPLE HOME-MADE RHEOSTAT.

Procure a board 1x2 inches and as long as you wish. Bore holes in it with a half-inch bit at equal distances apart, making one more than the number of resistance coils you are to use. From thin copper cut strips ¼ inch wide and about 2¼ inches long. Put two strips through each hole and bend down and fasten. Be sure that the strips do not touch each other at any place. On one side of the row of holes fasten a separate wire to each piece of copper, while on the other side one wire connects the strips of copper together. This latter wire is run to a binding post. To the first strip of copper on the opposite side a binding post is connected, and resistance coils are fastened between the copper strips by connecting the ends to the separate wires as shown in the illustration.

The resistance coils should be made of No. 22 German silver wire and should contain about 18 inches for each coil. This will give a resistance of about ½ ohm for each coil. If a finer adjustment is desired less wire should be placed in each coil and more coils be used in the rheostat.

A piece of wood is next made into the shape of a cone and covered tightly with a piece of brass. When this is thrust into one of the holes it completes the circuit. All of the resistance coils which are beyond the



Efficient Form of Rheostat Using Plug Type Switch.

cone from the binding posts are thus thrown out of circuit.

Contributed by C. A. SHOWMAN.

RECIPES FOR MAKING VARNISH, MUCILAGE AND CEMENT.

1. Sealing Wax Varnish.—Dissolve sealing wax of any color in strong alcohol. This is likely to be a rather brittle varnish.

2. Tannin Varnish.—Alcohol (95 per cent.), 20 parts; turpentine, 1 part; tannin, 4 to 5 parts.

3. Wax Varnish.—Wax (pure), 5 ounces; oil of turpentine, 1 quart. Dissolve. Used for furniture.

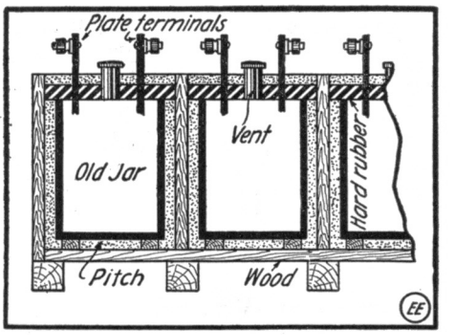
4. Linseed Mucilage.—Linseed, 1 ounce; warm water, 6 ounces. Digest for six hours, stir and then strain.

5. Plumber's Cement.—Black rosin, 1 part; brick dust, 2 parts. Heat until they are thoroughly mixed.

Contributed by CHAS. ROSENTHAL.

REPAIRING STORAGE CELLS WITH DAMAGED JARS.

It often happens that storage cells, especially of the ignition or portable type, have their hard rubber containers cracked. Not only is it difficult in some cases to readily procure a new container for the battery but



Scheme for Repairing Cracked Storage Battery Jars.

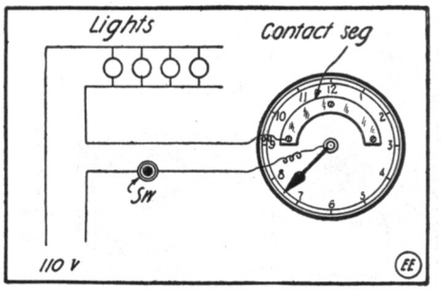
it is also quite a job to remove the sealing compound and the plates of the battery from the old jar. A suggestion is given herewith and also illustrated to circumnavigate this oft encountered battery trouble. If such a jar is to be used it will be found a very good plan to provide a wooden box, having as many compartments as there are cracked battery jars, each of the interior dimensions of the separate compartments being about one-half inch larger than those of the outside of the jar. The battery may rest on wooden sticks, or better yet, it may be suspended from above by means of a piece of stout cord.

A good insulating compound is then melted and poured in around the battery jar, and when it has hardened it will be found that the combination will hold acid all right. Pitch may be used for this purpose. To make the battery quite portable in case it has been opened, a hard rubber or hard wood cover may be made to cover the box, with slots in it through which the terminals of the plates can protrude, as well as the gas vents, and then insulating compound may be poured over the top.

Contributed by S. C.

A SIMPLE TIME SWITCH.

Procure a large clock with a wooden dial, removing all the hands but the hour one, to which rivet a piece of phosphor bronze, as shown in the illustration. Then take a semicircle of brass and cut it so that it will cover the time that you desire the lights to burn. Bore three holes in it and screw it to the wooden dial. Care should be taken to insulate this piece of brass from the remainder of the clock. All sharp edges on the brass should be filed off and rounded. Connect up as shown. A relay or mercury



Time Switch Constructed from Any Clock.

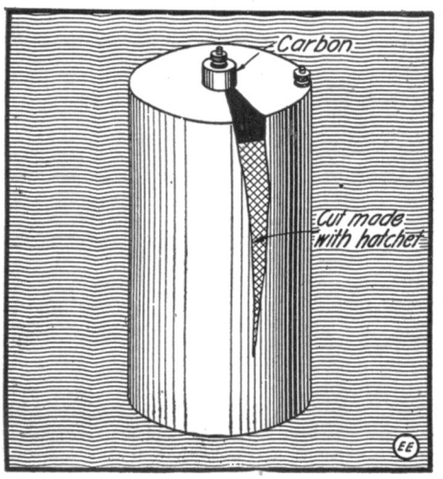
switch with relay attachment is best employed in such circuits.

Contributed by LOUIS GOODMAN.

Fill up slots on back of instrument bases with molten pitch from old dry cells.

TO REMOVE BATTERY CARBONS.

Electrical experimenters are often brought to chagrin and disappointment by the results of their efforts in attempting to extract a dry battery carbon without breaking it. The following is a very convenient and reliable method to pursue: Remove the sealing wax on the top surface. This can be used for thumb-screw knobs, insulating, etc., as explained in previous articles in *The Electrical Experimenter*. Then take a small hatchet and cut the zinc coating down toward the bottom. The battery must be standing upright to do this.



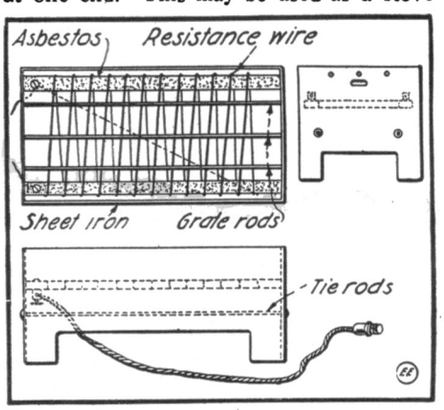
Cutting Open Old Dry Cell Cases with Hatchet to Preserve Carbon.

Then move the carbon back and forth gently until it is loose. It can then be easily pulled out without breakage.

Contributed by J. PALLAZZO.

CHEAP AND SIMPLE TOASTER.

The construction of this toaster will be readily understood by the accompanying illustration. It is used on 110 volts. The heating element consists of about eight feet of No. 26 nichrome wire wound around two bars of asbestos (see illustration). The connection is made to the toaster from the 110-volt mains through two binding posts at one end. This may be used as a stove



An Electric Toaster Easy to Make and Very Useful These Days.

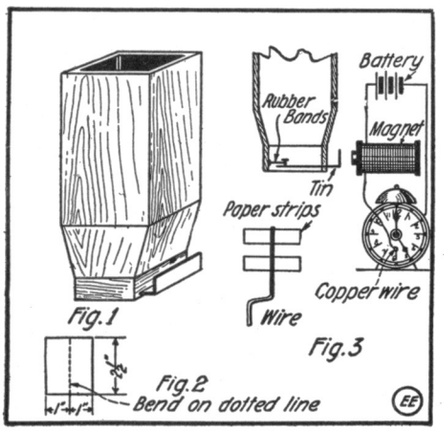
by placing the cooking utensil on the grid and will be found to be a most useful article.

Contributed by MONROE F. DREHER.

ELECTRICAL FEED BOX FOR PIGEON OR CHICKEN COOPS.

The feed box, Fig. 1, may be of any size, but the slot on the bottom should not be much bigger than ½x2½ inches, as then the tin plate (Fig. 2) would have to be bigger and the actuating magnet coil more powerful.

The box is filled with grain, and the tin plate inserted in the slot, and two rubber bands attached to back of slot. The magnet should be placed about 1 inch from



Electro-magnetic Feeder for Chicken or Pigeon Coops.

the tin plate. The wire on the dial of the clock should be very thin and should be fastened to the paper dial by small strips of paper as in Fig. 3. Thus, when the hour hand slides over the wire, it will close the circuit, and the magnet will pull the tin plate out of the slot, and the grain will run out of the box (see Fig. 1). As soon as the hand has passed over the wire, the circuit will be opened, and the rubber bands will pull the tin plate back into place and stop grain from running out. About 3 dry cells will work the feeder successfully. The wire on the dial may be placed at any desired hour that you wish to feed the fowls. The wire should not be any longer than ⅛ inch. The longer the wire, the longer it will take the hand to pass over it, and the more feed will run out and vice versa.

Contributed by EDW. HLAWATI.

PRESERVING COPIES OF THE "EXPERIMENTER."

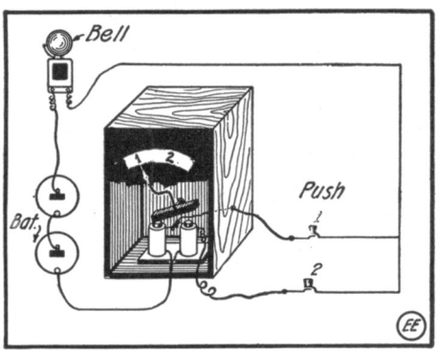
The following may be of use to readers who would like to preserve their copies of *The Electrical Experimenter*, as well as to have them handy when needed.

Take the magazines and punch a hole 2½ inches from each end, in the margin on the left side. Then procure two binding-posts, such as those found on old dry cells, and insert one in each hole; placing small copper washers next to the paper.

Contributed by GEO. W. BELLAMY.

HOME-MADE ANNUNCIATOR.

To construct a home-made annunciator first make a box as shown, and pivot a



Easily Made Electric Annunciator.

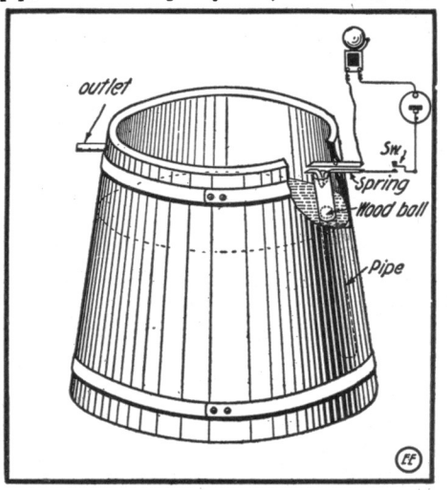
piece of iron over two electro-magnets as depicted, to which is attached an indicator.

Contributed by BERTRAM SCHWARZ.

ANOTHER WATER TANK ALARM.

A simple alarm that informs you when your elevated tank has become full of water can be made by following the diagram and outline below. Secure a 1½-inch pipe, a wooden ball 1¼ inches in diameter, an electric bell, two batteries, some bell wire, a piece of an old watch spring and a ball switch.

Fasten the pipe to the inside of the tank so that its lower end will be ¼ inch from the bottom of the tank, then drop the wooden ball into the pipe. Through the top of the tank and directly over the pipe drive a 40 penny nail, so that it will



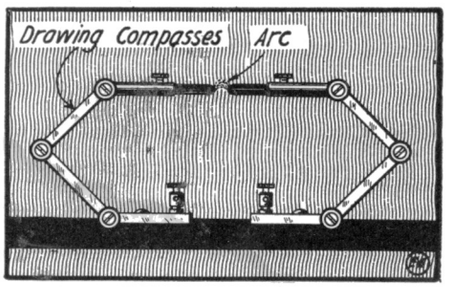
Wooden Ball Floating in Pipe Actuates High-Water Alarm Switch.

be about ¼ inch from the top of the pipe. On the side of the tank between the nail and the pipe fasten the piece of watch spring. Now connect the spring, batteries, bell, the switch and nail as the diagram shows. As the tank begins to fill with water the wooden ball will rise in the pipe until it reaches the top, where it forces the spring up against the nail, thus closing the circuit, ringing the bell in the house. The switch in the house may then be turned off so as to stop the bell ringing.

Contributed by HOWARD M. HARRIS.

SIMPLE BATTERY ARC LAMP.

This is how I made a small battery arc lamp:

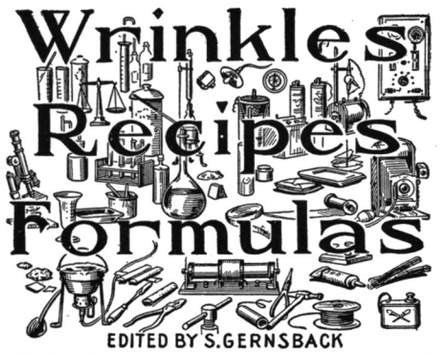


Battery Arc Lamp Made from Pair of Drawing Compasses.

I took two drawing compasses and fastened them to a hardwood board 4 by 6 inches with screws and placed a binding post on each compass. I then took two carbon pencils out of a small flashlight battery and put them where the pencils were previously in the compasses. By raising or lowering the legs of same, the carbons are brought together or apart.

This will work on 12 or 16 volts, although the arc is not permanent. An electric arc to burn free requires 40 volts.

Contributed by WALDO STAMBAUGH.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 21.
Perfumery.

In all the following formulas secure the best ingredients regardless of price. Quality is of the first importance. Procure the best spirits of deodorized alcohol obtainable. When the perfumes are mixed they should be frequently agitated and allowed to stand two or three weeks before filtering. *Age improves all perfumes,* if kept in a moderate atmosphere and in a dark place.

French Jockey Club Bouquet.—Esprit de Rose, 1 pt., *Esprit de Tuberose,* 1 pt.; *Esprit de Cassie,* ½ pt.; *Esprit de Jasmine,* ¾ pt.; *Extract Civet,* 3 oz.

The Guard's Bouquet.—Esprit de Rose, 2 pts.; *Esprit de Neroli,* ½ pt.; *Extract Vanilla,* ½ pt.; *Extract Orris,* ½ pt.; *Extract Musk,* ¼ pt.; *Otto of Cloves,* ½ dr.

Yacht Club Bouquet.—Extract of Santal, 1 pt.; *Extract of Neroli,* 1 pt.; *Extract of Jasmine,* ½ pt.; *Extract Triple Rose,* ½ pt.; *Extract Vanilla,* ¼ pt.; *Flowers of Benzoin,* ¼ oz.

Japanese Perfume.—Extract of Triple Rose, ½ pt.; *Extract of Vitivert,* ½ pt.; *Extract of Patchonly,* ½ pt.; *Extract of Cedar,* ½ pt.; *Extract of Santal,* ½ pt.; *Extract of Verveine,* ¼ pt.

Lavender Extract.—Oil of Lavender (English Mitcham), 4 drs.; *Essence of Rose,* 2 oz.; *Best Alcohol,* 14 oz.

Lily of the Valley.—Essence of Tuberose, 8 oz.; *Essence of Jasmine,* 1 oz.; *Essence of Orange Flowers,* 1 oz.; *Essence of Cassie,* 2 oz.; *Essence of Rose,* 2 oz.; *Spirit of Rose,* 1 oz.; *Tincture of Vanilla,* 1 oz.; *Oil of Bitter Almonds,* 2 drops.

New Mown Hay.—Tincture of Tontka, 4 oz.; *Tincture of Musk,* 1 oz.; *Tincture of Benzoin,* 1 oz.; *Spirit of Rose,* 1 oz.; *Oil of Rose Geranium,* 40 min.; *Oil of Bergamot,* 40 min.; *Rectified Alcohol,* 1 oz.

Moss Rose.—Spirit of Rose, 9 oz.; *Essence of Orange Flowers,* 3 oz.; *Essence of Rose,* 2 oz.; *Tincture of Civet,* 1 oz.; *Tincture of Musk,* 1 oz.

White Rose.—Oil of Turkish Geranium, 2 oz.; *Oil of Bergamot,* 2 oz.; *Extract of Benzoin,* 2 oz.; *Extract of Vanilla,* 2 oz.; *Alcohol,* 2 gals.; *Water,* 2 pts.

Violet Extract.—Essence of Violet, 4 oz.; *Essence of Cassie,* 1 oz.; *Essence of Rose,* 3 drs.; *Tincture of Orris,* 1 oz.; *Tincture of Ambergris,* 2 drs.; *Tincture of Civet,* 2 drs.; *Spirit of Almond,* 20 min.

Ylang-Ylang.—Spirit of Ylang, 8 oz.; *Spirit of Rose,* 4 oz.; *Essence of Jasmine,* 2 oz.; *Tincture of Civet,* 2 oz.

IMITATION GROUND GLASS AND OTHER WRINKLES.

Below you will find several useful recipes.

No. 1. *To Restore the Elasticity of Rubber.*—Immerse the article in a mixture of water of ammonia, 1 part, and water 2 parts until the object recovers its former smoothness.

No. 2. *Cleaning Compound.*—Mix 1 ounce of borax and 1 ounce gum camphor with 1 quart boiling water; when cool add 1 pint of alcohol, bottle and cork tightly. When wanted for use, shake well and sponge the article to be cleaned. This is an excellent mixture for cleaning soiled black cashmere and woolen dresses, coat collars and black felt hats.

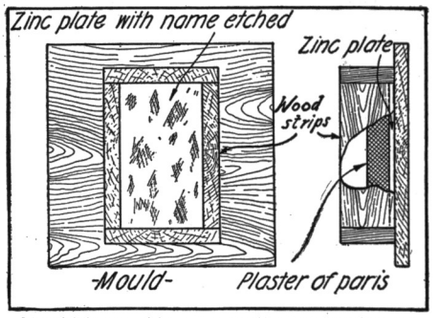
No. 3. *"Handy" Water Pen.*—Take best quality violet aniline, reduce to a thick paste with water, then add mucilage and mix thoroughly; apply the paste thus made to the pen and let it dry 12 hours. Any steel pen may be prepared in this way. Directions for using: Start action by dipping in water up to filling. If pen should be greasy, wet point with the tongue. To make the ink flow thick, dip to the filling, if wanted thin or pale, dip only to the eye of pen after starting. After using throw water off, but don't wipe it, for it will dry in a minute.

No. 4. *Ground Glass, Imitation of.*—Paint the glass with the following varnishes: Sandarac 18 drams, mastic 4 drams, ether 24 drams, benzine 6 to 18 ounces. The more benzine the coarser the grain of imitation glass will be.

Contributed by
ARTHUR D. OETJEN.

A FACSIMILE RUBBER STAMP.

The following is a simple method whereby amateurs can make their own rubber



Mould for making Facsimile Rubber Stamp

stamps. Place a piece of carbon copying paper face up upon a smooth table. On top of this place a piece of paper and write the desired name on same. The design will then be found traced upon the back of the paper and will read backwards.

Then place the carbon paper face down upon a smooth piece of zinc and the writing paper also face down on the carbon paper.

Now go over the reversed name on the back of the paper, thereby tracing the same design upon the zinc. After this go over the lines on the zinc with an acid-proof ink, made by mixing equal parts of pyrogallic acid and sulphate of iron. When dry apply hydrochloric acid to the face of the zinc, and after it has eaten deep enough wash off in running water.

A plaster cast is then made by pouring plaster of paris, mixed with water, upon the zinc, which is laid face up in a mould similar to that shown in illustration. When hard remove the cast and the impression will be found in same.

For those who are not experienced at vulcanizing rubber, or who do not care to go to the trouble, they can employ the following method:

India rubber, cut up in small pieces, is dissolved in highly rectified spirits of turpentine until semi-fluid. This mixture is then poured into the plaster cast, which has been previously dusted with powdered graphite. When hard it is removed and mounted.

The zinc can also be mounted type-high on a block of wood and used in a printing press.

Contributed by
GEO. NIEDERHOFF.

MAGIC SERPENTS FOR PYROTECHNICAL DISPLAYS.

Any of the three formulas given herewith will produce the same effect when properly compounded as the ones which are for sale in the form of a pyramid or an egg.

1. Fuse in a crucible the following mixture: Prussiate of potash 46 parts, carbonate of potash 16 parts, sulphur 32 parts. The heat should not be allowed to go beyond a dull red and the mass should be removed from the fire when thoroughly fused. When cold dissolve the mass in water and filter off the clear portion. To this latter is added nitrate of mercury as long as the precipitate is thrown down, which is washed in many changes of water, collected on blotting paper, dried, rolled into little pyramids or eggs and covered with tinfoil. They are now ready for ignition. The mixture thus compounded is sulpho-cyanide of mercury, which can be produced by the following method if preferred:

2. Metallic mercury is dissolved in dilute nitric acid, taking the precaution of having an excess of the metal. Decant solution and add to it a saturated solution of sulphocyanide of ammonium. The precipitate which falls must be collected and washed in several changes of water and finally dried. Mix in a mortar this dried mass with a little gum water to make a pasty mass, but as dry as possible. The compound now formed may be pressed into eggs as already described.

These two compounds as described are both *extremely poisonous.* The next has not this disadvantage and the residue may be used to polish brass.

3. Bichromate of potash 2 parts, saltpeter 1 part, white sugar 3 parts. Pulverize these ingredients separately and mix thoroughly and press into cones of paper. These cones should be covered with tinfoil and varnished.

Contributed by JAMES DAVIS.

A GOOD SILVER POLISH.

Mix together one-half ounce of fine salt, one-half ounce of powdered alum and one-half ounce of common cream of tartar. Put them into a large porcelain pitcher and pour on two quarts of water and stir till entirely dissolved. Now transfer the mixture to clean bottles and cork tightly. Before using, shake well. Pour a little of the liquid out into a bowl and wash the silver all over with it, using an old linen cloth. Let it stand for 10 or 15 minutes, and rub off dry with a buckskin. The silver will look like new.

To Clean Brassware.

Mix one ounce of oxalic acid, six ounces of rotten stone in a powder, one ounce of sweet oil and enough water to make a paste. Apply a small amount and rub dry with a flannel. This is a lot better than most of the polishes, as it will not corrode the brass as do polishes that contain nitric or other acids.

Contributed by FRANK SAUNDERS.

Obtain an operator's license now. Don't wait until you can receive a little faster. It gives you a first-class standing among the experimenters when you have been recognized by the Government.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

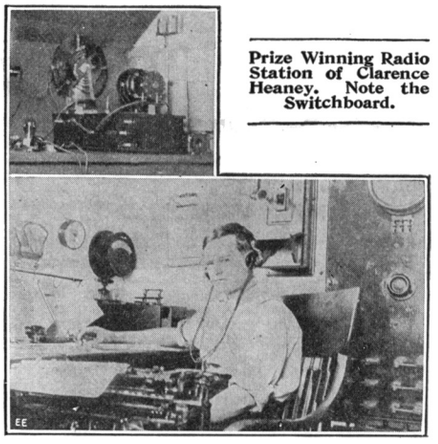
CLARENCE HEANEY'S WIRELESS STATION.

With this description of my station a photograph is also being submitted. The station has given excellent results and has been the source of an endless amount of pleasure and excitement.

Most of the apparatus has been constructed in my shop from knowledge obtained through *The Electrical Experimenter.*

The receiving set contains 1 E.I.Co. tuner, which has been reconstructed and designed so that the inductance is variable by means of a 30 point switch mounted on one end and moreover connected so that the dead end effect is eliminated, as described in a recent issue of this journal; an E.I.Co. Universal detector, Murdock silicon detector, Halcum loose coupler, E.I. Co. potentiometer, Radioson detector, 3 pairs of Western Electric 'phones and 4 switches. With the Radioson detector, potentiometer, loose coupler and a pair of 1,200-ohm 'phones, I have been able to copy the Honolulu station without difficulty. I have used carborundum, galena and molybdenite, but find the Radioson the best of all.

On the sending side, the oscillation transformer, power transformer, condenser and gap can plainly be seen in the illustration. The most interesting piece of apparatus is the oscillation transformer which was constructed from two old type E.I.Co. helices. This makes a neat, compact and efficient piece of apparatus. The rotary gap is also home made and by special arrangement of stationary and rotary electrodes, it emits a pure musical note similar to the Marconi



Prize Winning Radio Station of Clarence Heaney. Note the Switchboard.

station at Bolinas. An E.I. Co. ½ K.W. transformer, mounted in a home made box, charges the Wireless Specialty App. Co.'s or Clapp Eastham condenser. With this transformer, helix, condenser and gap, I have been able to do excellent work. I sign 6 AAC.

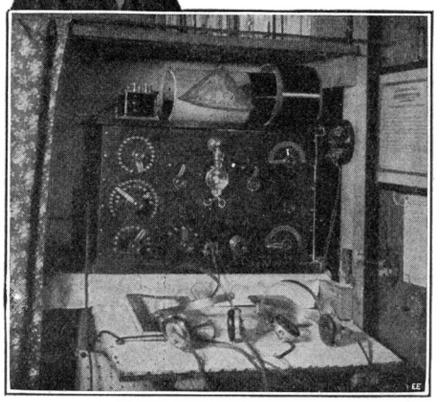
CLARENCE HEANEY.

San Francisco, Cal.

RADIO LAB. OF MAX KUHNE.

Following is a description of my radio receiving set: It is of the cabinet type and comprises an inductive tuner, loading coil, primary condenser, secondary condenser, audion detector with set of high voltage batteries and rheostat, and a pair of E.I. Co. 3,000 ohm 'phones. All instruments are mounted inside of the cabinet controlled by two hard rubber knobs.

Efficient Radio Laboratory of Max Kuhne, Hoboken, N. J. A Curtain Keeps the Dust Away When Apparatus Is Not in Use.



The cabinet, loading coil and loose coupler, as well as all other parts such as switches, contact points, etc., were constructed at home with the help of my brother. In connection with my aerial, which is of the inverted "L" type, 65 feet long, 70 feet high, 2 wires, I can tune up to about 6,000 meters.

The results I attain with this set are excellent. Connected to the amplifier, which may be observed on top of the cabinet, I am able to read the signals nearly all over the house. I hold a first grade amateur operator's license.

MAX KUHNE.

Hoboken, N.J.

RADIO AIDS LEAP YEAR CUPID.

Cupid put over a new one recently.

Miss Mildred Whitehouse was Dan's agent. She came to New York City from Round Hill, Conn., and seemed very anxious to send a message to a friend on the *Tenadores,* a United Fruit liner en route to Havana. It was a very dear friend, she explained to the man in the telegraph office. This is what she sent:

"To Howard Whitcomb: I've changed my mind. Will you have me? It's leap year, remember. Wireless answer. I'm waiting."

This reply came from somewhere at sea:

"Some Valentine! Coming back by next boat. HOWARD."

Cupid winked and went his way. So did the clerks of the United Fruit Line when asked to verify the story.

FUGITIVE CAUGHT BY WIRELESS.

Wireless telegraphy located an alleged forger recently on the steamer *Grafton Hall,* which sailed from New York January twentieth for Buenos Aires.

The hunted man and his wife were strolling the deck of the ship when the message from Chicago reached the vessel. They were arrested when the ship arrived at the Barbadoes Islands.

MISS CAMPBELL A RADIO ENTHUSIAST.

It seems strange that so few young women are interested in wireless telegraphy. However, I had a special reason for my interest in the science aside from the fascination which has attracted me to it.

Some might suppose that my interest was aroused through having a brother or someone in the home interested in the subject, but such is not the case.

My reason for taking up wireless was due to my desire to install an outfit on my father's yacht. Consequently I purchased the apparatus here described and began studying in order to pass the examinations for a license. All operators on ships are of course required to have a license. I took my examination. July 9, 1915, at the Navy Yard, Boston, and received my certificate the following day. I did not attend any school of telegraphy.

My receiving set is of the cabinet type and consists of 2,000 ohm Murdock 'phones, loose coupler, Clapp Eastham tuning coil, Murdock loading inductance, fixed condenser, two Murdock variable condensers, ferron, silicon, galena and iron pyrites detectors.

I receive WCC, NAA and boats at sea, I hear Uncle Sam's warships when they are practising their war games and maneuvers off the coast here.

The transmitting set consists of a two inch spark coil, two Leyden jars, helix, spark gap and key.

Miss Margaret Campbell, Who Learned Radio Operating Herself.

Above: The Excellent Wireless Sending and Receiving Set of Miss Campbell.

As our yacht is nearing completion I have not yet had the opportunity to test my set aboard ship, but am looking forward with great anticipation to the opening of the yachting season.

MARGARET LAVINA CAMPBELL.

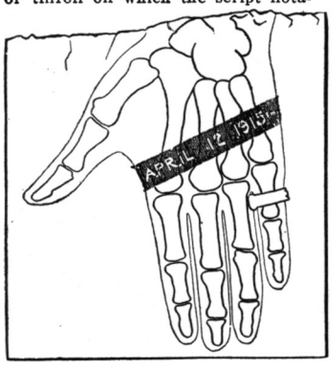
Rockport, Mass.

LATEST PATENTS

Label for Skiagraphs.

(No. 1,168,177; issued to Aurelius de Yoanna.)

A very simple scheme for labeling skiagraphs employing a strip of lead or tinfoil on which the script nota-

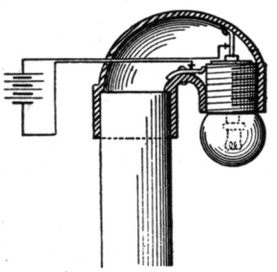


tion is impressed by means of a lead pencil or any blunt instrument, which will compress the tinfoil at that point and thus make it more transparent along the script lines, to the X-ray. An idea of very wide application.

Electric Pencil Light.

(No. 1,169,029; issued to Luther M. Gunnerson, assignor of one-half to N. P. Gunnerson.)

Another patent on an electric light attachment for ordinary pencils and the like. The invention covers only an insulating tube of the shape

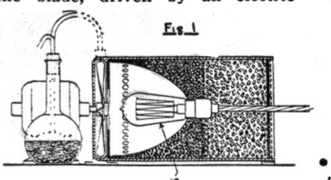


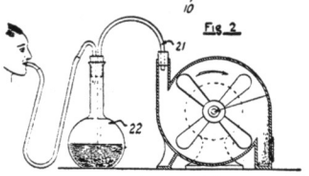
indicated and adapted to fit a pencil and also to contain an electric lamp receptacle. Two wires from the receptacle lead out to an external battery. This device would seem adaptable to use with a fountain light battery, which is already on the market.

Electric Air Purifier

(No. 1,170,526; issued to Wallace H. Gaither.)

This is an electric air purifier comprising a cylindrical chamber containing calcium chlorid and charcoal. Through these clarifiers the air is sucked by a high speed turbine blade, driven by an electric



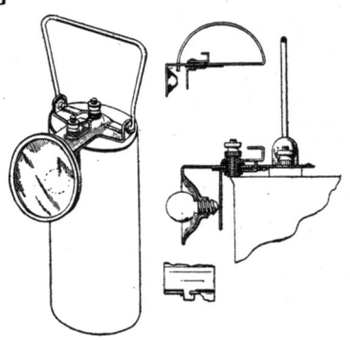


motor, as perceived. Moreover in passing into the turbine chamber, the air is acted upon by the chemical light rays produced by an electric light, arc, or spark placed within a reflector at 10. The purified air then passes out through a section of tube 21, and thence through a wash bottle 22. The device is intended for use by patients themselves and especially for physicians' requirements. Any degree of humidity or any medicinal property may be given to the air in this way and its natural vitalizing factors are not eliminated in the process here set forth, it is claimed.

Portable Lamp Attachment.

(No. 1,167,707; issued to Frederick W. Mebold.)

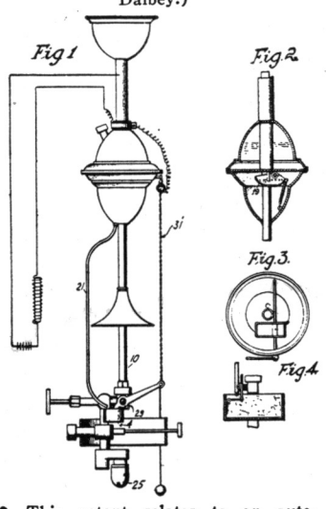
Another design of battery lamp attachment, suitable for use on standard dry cells and incorporates a carrying handle, switch and lamp receptacle, as perceived from the illustration. The design is quite unique in that it involves but very few parts. The zinc electrode of the cell connects through the switch blade and the switch point connects to the back (cen-



tral) electrode of the lamp. The other lamp connection leads to the carbon binding post of the cell.

Automatic Gas-Electric Generator for Chandeliers.

(No. 1,167,680; issued to Joel Benj. Dalbey.)

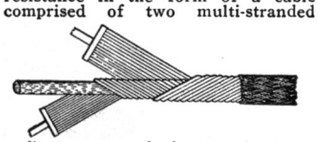


This patent relates to an automatic gas-electric generator suitable for use on chandeliers, as the illustration shows. A tank is mounted on the chandelier stem, which contains a fuel such as kerosene or gasoline. A small quantity of this fuel drops downward into a cup which later may be emptied by pulling a control chain 31. When this action takes place, the quantity of fuel released by the catch basin 19 passes down through a small tube 21 into a cup 4. An insulated contact finger 29 causes an ignition spark to take place and the oil in the pipe 21 is vaporized. This now passes down through the main supply channel 10 and can then be used to light up a suitable gas mantel 25 or stove et cetera.

Electrical Resistance Cable.

(No. 1,170,811; issued to Charles E. Hay and Herbert W. Sullivan.)

A very clever form of electrical resistance in the form of a cable comprised of two multi-stranded

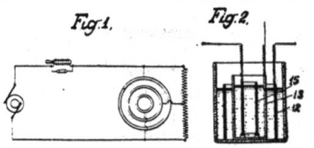


conductors wound about each other, as the illustration shows. These in turn have a central core made of some insulating material. The two conductors forming the resistor, may be wound in the same or opposite directions, preferably the former. The two layers of the conductors are also properly insulated with respect to one another. This form of resistor design is of superior efficiency in all laboratory measurements and results in the minimum inductance effect.

Electrolytic Rectifier.

(No. 1,165,983; issued to Alexis le Blanc, assignor to Gurney Electric Elevator Company.)

Improved form of electrolytic rectifier intended to economize greatly in the amount of space necessary for its installation. It involves the use of electrodes in the form of cylinders. The aluminum electrode 13 is properly insulated from the lead or iron electrodes 12 and 15. In the diagram shown for this form of rectifier, two coils of

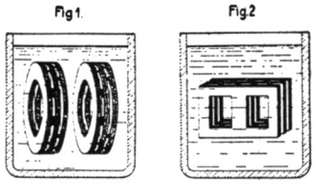


a D.C. lifting magnet are indicated. The rectifier is intended for use on elevator braking magnets and the like, but may be used for charging batteries, etc., from A.C. mains and an adjustable choke coil is placed in series with the current supply as indicated, but a lamp many be substituted for same.

Frequency-Converter.

(No. 1,169,676; issued to Paul Fernand Pichon and Alexander Meissner, assignors to Gesellschaft Für Drahtlose Telegraphie M.B.H.)

An innovation in design of radio frequency transformers employing a finely laminated iron core, immersed in paraffine oil which helps to carry away the large amount of heat produced in such iron cores operating at frequencies of 200,000 cycles per second and the like. The inventors claim it is possible with their design of frequency converter transformer, employing an iron core with the flux in same at a density approaching

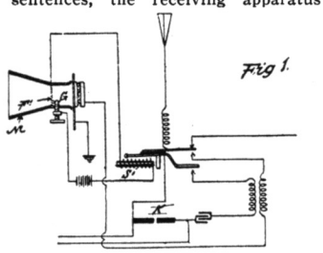


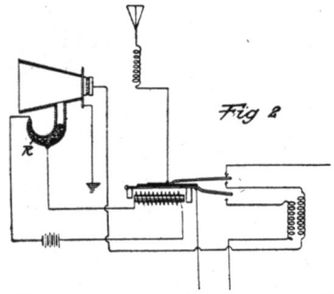
the saturation point, to realize an efficiency of almost 0.5 kilogram of iron per kilo-volt-ampere of transmitted energy, as compared to the usual quantity utilized of from 2 to 10 kilograms of iron necessary in transforming 1 kilo-volt-ampere of energy.

Automatic Switch for Radiophones.

(No. 1,170,882; issued to Lee de Forest.)

An automatic, voice-controlled switch for changing the talking and receiving connections in radiotelephonic systems. This device automatically connects the transmitting apparatus to the antenna and ground when a person speaks into the microphone mouthpiece M. A vibrating reed F1 in the mouthpiece makes contact with a platinum tipped electrode G. In this way a circuit is controlled through a slow moving telephone relay S1. As soon as the person stops talking, including the time interval between sentences, the receiving apparatus

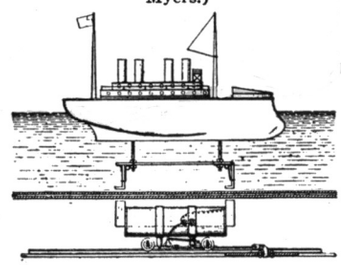




is connected to the antenna and ground. A second scheme for accomplishing identically the same results is shown in Fig. 2 and involves the capillary action of a small quantity of mercury placed in the tube R of the shape indicated, which connects and disconnects the relay circuit as aforedescribed and for similar purposes.

Magnetic Movement Device for Model Boats.

(No. 1,171,972; issued to Louis E. Myers.)



An electromagnetic device in the form of a small four-wheeled car intended to run along on tracks beneath a tank in which model steamers float. The steamer has two soft iron pole shoes extending from its keel, and these are provided with spring hinges, so that in case the vessel in moving forward should encounter any projections the said shoes can spring back and upward and after passing such obstructions, they will, as becomes evident, resume their normal position, as shown in the illustration. The traveling electro-magnet is ingenuously constructed with a pivoted two section truck, which allows it to negotiate any form of curve no matter how sharp. It receives the exciting current through the rails upon which it travels

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

O. I. C. U. R. A. BOOB OF ST. HELENA, HEL.

BOMB DETECTOR

18// C. O. D. **Specification Specified A. D. 96 B. C.** **Patent Amplified**

To All Kings Who Fear Bombs, Anarchists, and Mr. Bryan:

Be it known that I, O. I. C. U. R. A. Boob, a citizen of St. Helena, Hel., in the State of Collapse, a subject of King Kingsbury, have perfected and infected a device which prevents bombs from being sent to Kings, Czarevitches and other vitches and all High Muck-a-mucks.

This invention relates to a means of detecting the presence of any hard or explosive substance contained in bottles of hair tonic, cigars, etc., which are sent to kings with malicious intent.

The action of the device is as follows: A package is placed in the mail chute, 1, and *en route* to the bottom, closes switch 2, which starts the motor. The package, after falling into the tank, standing on its tiptoes, starts across the latter, moved by the belt, 3. In most cases it will be drawn into the tin-lined stomach of the electric Fish *detecticus bombicus,* but if it escapes this sad fate, it will press against the contact 4. This starts a motor which lifts the package by means of the hook 5 until switch 6 is closed. At this moment the magnet 7 releases the hammer 8. Just as the package falls, down swings the hammer and gives it a swooping, swift-swinging, swiping and sweeping swat and sends it up the tube, 9, as indicated by the arrows.

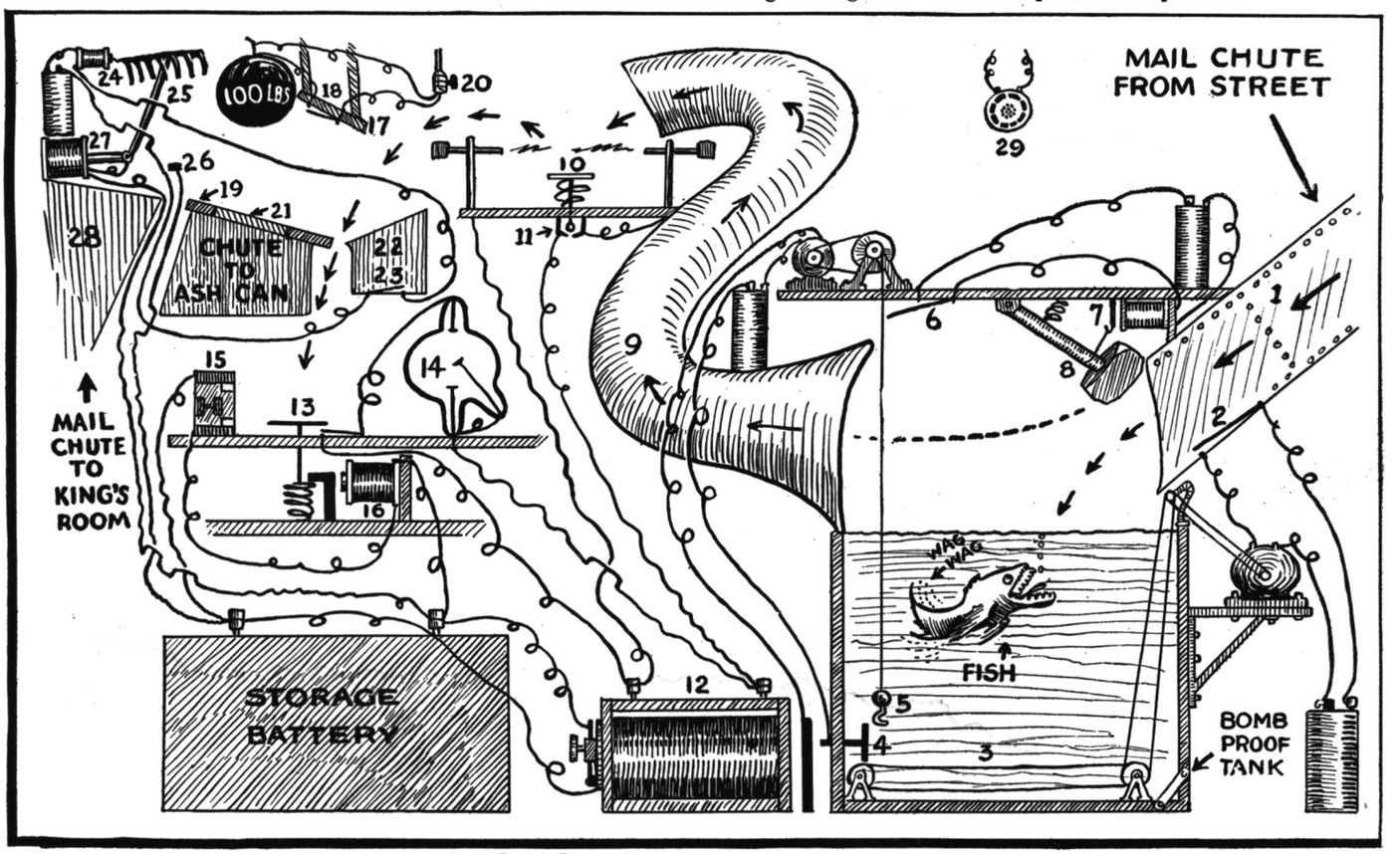
As the package lands on platform 10, a blinding flash of light appears and the contents of the bundle are pierced through and through by the oscillatory discharge of the electric current. If, at this point, the bomb is not exploded, it will be soon, notwithstanding nevertheless.

When the spring under the piston 10 expands, it sends the package on its way as indicated. After a pleasant journey, it lands on the platform 13, closing the switch under it. This connects the cathodic ray machine which directs an ionic discharge through the bundle. If the package contains no metal the rays will strike the selenium cell 15, and by means of the magnet 16, which is energized as the light strikes the cell, the spring beneath the platform is released.

The action of the spring throws the package up against the rubber plate 17, where it closes the switch 18, and bounces to the sloping shelf 19. The enormous weight shown above it is composed of concentrated hydrogen atoms. As the switch 18 is closed, the fuse which upholds the weight is lighted. Then when the fuse blows the weight drops upon the package. If it contains anything hard, it will be forced through the trap door 21, and into the ash can, but if it is soft, the force of the falling weight will be absorbed and the shot will roll into the can 22. At this moment the switch 23 will be closed, actuating magnet 24. This will allow the rake 25 to drop and dropping it will strike the contact 26. The final act is when the solenoid 27 draws in the rake and pulls the package up to the mail chute, which goes to the king's "boodoir."

What I claim is:—

1. A device which will positively detect the presence of any gun powder, face powder or explosive foot powder.



Bum Bomb Buster for Cringing King's Correspondence

2. A device which will give the king the pleasure of hearing the bomb go off by means of the microphone 29 without necessitating the removal of his gouty foot from the royal foot stool.

In testimony whereof I set my name, and witnessed this eleventeenth day of March in the year when George Crossington washed the Delaware.

O. I. C. U. R. A. BOOB.
By his attorney,
H. C. Miner, Jr.

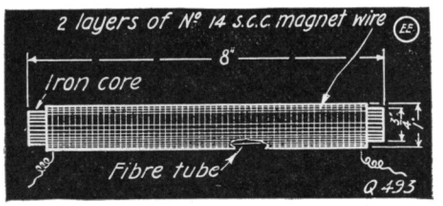
Witnesses:
Cesar Rex II the IVth.
Duka del Wazzematta Wopuzzi.
Prinz zu Schwademagenleberwurstfresser.

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail, except as stated below.

Choke Coil Data.

(493.) L. W. Passey, Logan, Utah, asks for: 1. Dimensions for the construction of a choke coil. 2. Why a ½-kilowatt transformer heats up when used on 110-volt, 60 cycle A. C. circuit? 3. Why the electric



Details of Choke Coil for ½ K. W. Transformer Circuits.

lights flicker when he operates the transformer?

A. 1. The illustration herewith given shows the dimensions for constructing a suitable choke coil.

A. 2. The primary of your transformer heats up due to the fact that the coil is wound with too fine a wire for carrying the load. This can be remedi d by rewinding the primary of the transformer with a larger size wire or else employing a choke coil in series with it to reduce the current.

A. 3. The reason the lights flicker when the key is pressed is because there is too much current being drawn by the transformer, which puts too great a load on the line.

Solenoid Winding.

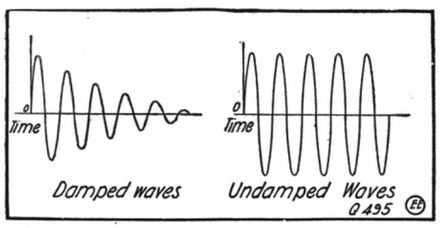
(494.) A. J. Nesbit, San Francisco, Cal., would like to know: 1. Whether a solenoid or magnet can be built to operate on a certain specified voltage, so that he can connect it with a 110-volt arc light operating on 110 volts, 40 amperes? 2. Whether there is any metal known that will withstand the temperature developed by the electric arc?

A. 1. It is possible to design and construct a magnet or solenoid to be operated in series with an arc lamp on your specified current and voltage.

A. 2. We do not know of any metal which will withstand the high temperature developed by the electric arc, although platinum will stand a considerable amount of heat, as also tungsten, tantalum and osmium, the latter fusing at 3,900 degrees Fah.

Damped and Undamped Waves.

(495.) F. W. Moore, Jr., Pensacola, Fla., inquires: 1. Whether he will be able to receive N. A. A. with the following instruments: E. I. Co. "Inter-Ocean" receiving



Showing Difference Between Damped and Undamped Waves.

set, variable condenser (17 plate), Murdock 3,000-ohm 'phones used on an aerial 65 feet high (4 strands, 55 feet long)? 2. The method which he can employ to increase the range of his station.

A. 1. With these instruments you should not have any trouble in receiving the Arlington station N. A. A.

A. 2. You can augment the range of your receiving set by increasing the length and height of your antenna and at the same time employing a more sensitive detector, such as the Audion or Radioson.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 letters addressed to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually published.

Kindly note, therefore, that in the future we can not, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first three ordinary questions and 25c. for each additional question. Will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addressed envelope should be enclosed with the queries and, moreover, any sketches accompanying same should be made on separate sheets. And please be brief.

THE EDITORS.

Dynamo.

(495-A) Jesse Roberds, Springfield, Mo., wishes to know: 1. Whether a five-bar telephone magneto can be converted into a generator to develop 10 or 12 volts? 2. The size and quantity of wire used. 3. Whether the current developed by this machine will be alternating or direct?

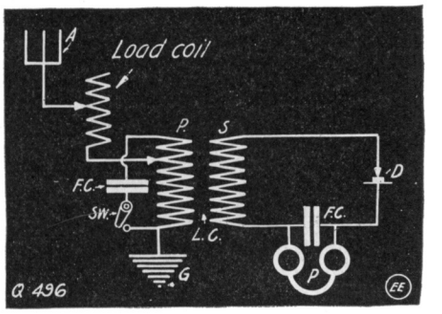
A. 1. The five-bar telephone magneto can be converted into a dynamo for generating 10 or 12 volts.

A. 2. The armature should be wound with No. 26 copper magnet wire, and it should contain at least 250 feet of this wire.

A. 3. The current developed by this dynamo would be alternating unless a commutator is provided, in which case it would be direct.

Radio Hook-up.

(496.) Herbert Dixon, Johnstown, Pa., wants us to give him: 1. The connections



Radio Receiving Hook-up.

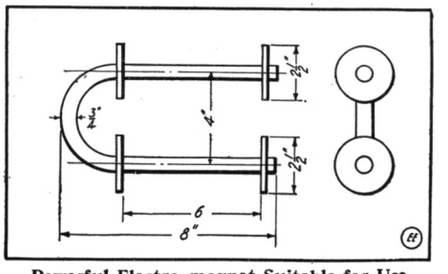
for the following instruments: Loose coupler, loading coil, two fixed condensers, galena detector and 'phones. 2. Information as to whether he will be able to receive the signals transmitted by Arlington with the use of a tikker?

A. 1. The accompanying illustration gives the proper connections for the instruments you mention.

A. 2. You will be able to receive the signals from Arlington and other continuous wave stations with a tikker made with a steel wire vibrating against a piece of silicon, or in any other way, as described in the March, 1916, issue.

Electro-magnet.

(496) Perry Spangler, Twin Falls, Idaho, wants us to give him: 1. The dimen-



Powerful Electro-magnet Suitable for Use on Batteries.

sions for building an electromagnet suitable for magnetizing a permanent steel magnet of a Ford type magneto. A1. The illustration herewith shows dimensions for building a suitable magnet.

(Continued on page 46)

JUST A FEW OF 1500

The Electro "Government" Phones

Highest Precision Phones Made in the United States

BANDS HARD RUBBER COVERED (Adopted by several Governments)

No. 6666

Designed and made for WIRELESS

This headgear is the lightest on the market to-day. **Each receiver is wound to 1500 ohms, giving 3000 ohms per set. The German silver HEAD BANDS ARE COVERED WITH HARD RUBBER, thereby affording the best possible insulation. NON-RUSTING DIAPHRAGMS.**

Other points of superiority: Light rubber cap, highest insulation, not only inside of the windings, to insure against breakdown, but the **headgear is entirely insulated from the phones themselves.** The swivel arrangement is of the latest approved style, so that the phones will fit the ear snugly to exclude all external noise. We use a six-foot pure silk covered cord with two tips.

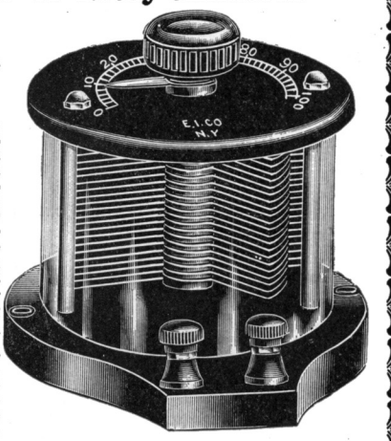
The magnets are wound with No. 43 B. & S. ENAMEL COPPER WIRE. The magnets are a great deal more powerful, being made of the best imported Swedish tungsten steel.

We lay particular stress on the magnets of this receiver and we guarantee that the magnets will not lose their strength for two years.

Price, $8.00

The Pride of Every Amateur

The "Electro" Rotary Variable Condensers



Consider these features: **FIRST—THESE CONDENSERS ARE THE ONLY ONES MADE WITH A TRANSPARENT CASE IN WHICH OIL CAN BE USED WITHOUT IT LEAKING.** In this way the condenser capacity can be increased **FIVE TIMES. SECOND—THIS CONDENSER IS THE ONLY ONE NOW ON THE MARKET WITH CONNECTIONS AT THE BOTTOM.** Cover is of highly polished hard rubber composition with **a large scale that is easily read.**

No. 9240 "Electro" Rotary Variable Condenser, 17 Plates, size 4⅛x3⅞ in. Shipping weight 2 lbs. **$2.75**

No. 9241 "Electro" Rotary Variable Condenser, 43 Plates, size 4⅛x3⅞ in. Shipping weight 3 lbs. **$4.25**

The "Electro" Vario Selective Coupler

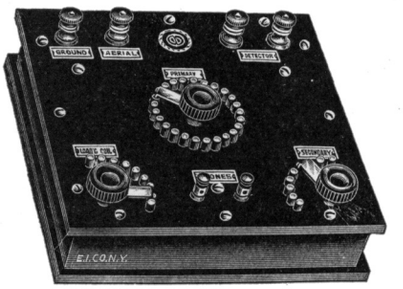
CABINET TYPE

This outfit can tune to wave lengths from 100 meters to 3,000 meters.

The entire cabinet is made of highly polished mahogany, with switches controlled by hard rubber handles, and the binding posts and metal parts of brass, nickel-plated.

Smallest and most compact long distance wireless receiving outfit manufactured.

No. 11000 "Electro" Vario Selective Coupler (no phones or detector). $6.50



No. 11000
Shipping weight 5 lbs.

Guaranteed "Electro" Storage Batteries

As Made by Us for 12 Years

This battery, which was first designed by us as an automobile battery (where it meets with the greatest abuse on account of shocks, etc.), is absolutely "fool proof." There is nothing to get out of order, and with ordinary care this battery will last for five years.

Every experimenter knows that there is practically no equal to a **good** storage battery. It is a pleasure to run your coil or other apparatus when you know there is lots of "juice" behind it. All batteries come in treated oak cases. There is absolutely nothing to corrode. Batteries shipped fully charged, ready to use. Shipped in strong wooden, non-overturning box. Full directions on every battery.

Any garage or power plant will recharge any battery for about 25 cents. If you have direct current, you can charge it yourself at a cost of 8-10 cents.

No. 2325 "Electro" Storage Battery, 4 volts, 40 ampere hours, size 7x7x3½ in. **$4.20**
Shipping weight 23 lbs.

No. 556 "Electro" Storage Battery, 6 volts, 40 ampere hours, size 5¼x8x8 in. **$6.25**
Shipping weight 35 lbs.

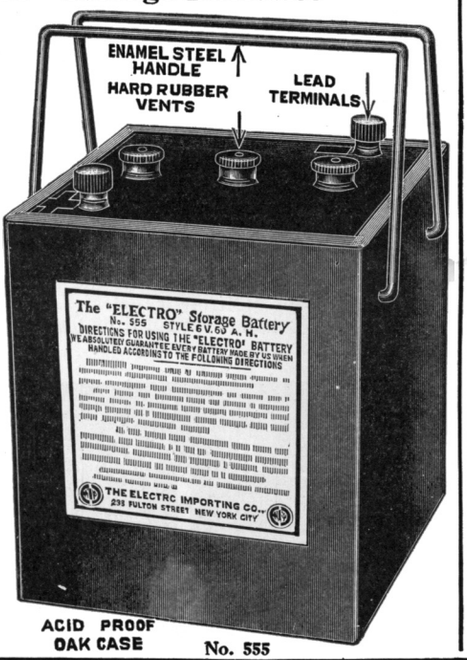
No. 2327 "Electro" Storage Battery, 4 volts, 60 ampere hours, size 7½x7½x5 ins. ... **$5.50**
Shipping weight 28 lbs.

No. 555 "Electro" Storage Battery, 6 volts, 60 ampere hours, size 6¾x8x8 in. **$8.00**
Shipping weight 41 lbs.

No. 2328 "Electro" Storage Battery, 6 volts, 80 ampere hours, size 9¼x7x8 in. ... **$12.00**
Shipping weight 60 lbs.

No. 2329 "Electro" Storage Battery, 6 volts, 100 ampere hours, size 12x7½x8 in. ... **$15.00**
Shipping weight 68 lbs.

THESE BATTERIES ARE SENT FULLY CHARGED

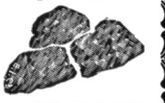

ENAMEL STEEL HANDLE
HARD RUBBER VENTS
LEAD TERMINALS
The "ELECTRO" Storage Battery
No. 555 STYLE 6 V. 60 A. H.
DIRECTIONS FOR USING THE "ELECTRO" BATTERY
WE ABSOLUTELY GUARANTEE EVERY BATTERY MADE BY US WHEN HANDLED ACCORDING TO THE FOLLOWING DIRECTIONS
THE ELECTRO IMPORTING CO.
236 FULTON STREET NEW YORK CITY

ACID PROOF OAK CASE No. 555

NEW! NEW!!
RADIOCITE

The most wonderful of all crystals. More sensitive than Galena, more sensitive than ANY other crystal or mineral.

The mineral that looks like liquid gold. Now in use by several governments. Equally sensitive all over. Used with a medium stiff phosphor bronze spring. Does not jar out easily. Sold by the piece only. Each crystal is tested and guaranteed. Each packed separately in a box. **Money refunded if our claims are not substantiated.**



Generous piece of tested Radiocite: $0.60 Prepaid.

We are the sole American Retail Agents for Radiocite. **IMMEDIATE SHIPMENTS. NO DELAY.**

"The Livest Catalog in America"

YOU MUST HAVE IT

ELECTRO IMPORTING COMPANY

I enclose herewith 4 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 16 containing 275 pages, 658 illustrations and diagrams, including Treatise on Wireless Telegraphy, complete list of all U. S. Wireless Call Letters, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.

Write your name and address in the margin below

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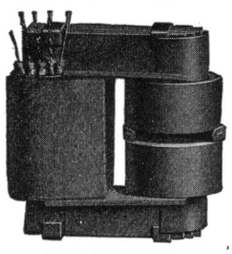


UNMOUNTED TRANSFORMER

You Can Get Results

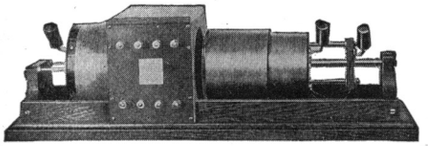
with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of the work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio



Type AML

The Precision Varicoupler

Patented Mar. 7, 1916, foreign patents pending.

Up-to-date receiving circuits require improved apparatus. You can't get supersensitiveness with old style couplers. The Precision Varicoupler is PERFECTION in receiving tuners. It has

No Taps **No Sliders**
No Switches **No Delicate Parts**
No "Dead Ends" **All the Wire in**
No Contacts **Use all the Time**

and is finished in mission oak, genuine cut hard rubber, silver finished wire, etc.

5 Styles, $10 to $25

For detailed information write for bulletin PL.

The Precision Radio Equipment Co., Inc.
General Office: 868 Putnam Ave., Brooklyn, N. Y.

Look! Only $3.90

To advertise more extensively we are making these big reductions for a short time. $5.00 tuner only $3.90. $8.00 tuner with switches only $5.50. "Your $5 tuner is the most selective and best for the money. R. L. Glocker, West Arlington, Baltimore, Md." Send 2-cent stamp for bulletins.

Colby's Telegraph School, Auburn, N. Y.

QUESTION BOX.

(*Continued from page 44*)

Transformer.

(497.) Hyman Wallur, Brooklyn, N. Y., wants to know: 1. Whether it is possible to construct a ¼-kilowatt transformer with a vibrator for use on a small battery consumption? 2. The current and voltage required for operating same.

A. 1. It is quite possible for you to construct a ¼-kilowatt open core transformer with a vibrator, but the current consumption would be quite high.

A. 2. This transformer may be operated on about 25 volts and would draw a maximum current of 13 to 14 amperes.

Radiophone Arc.

(498.) Rudolph Krojick, Cleveland, O., asks us: 1. What direction he can receive best from with an antenna which is erected according to the diagram he submits? 2. Whether a rectified alternating current can be used for a D. C. radiophone arc?

A. 1. The best direction in which you can receive from with your antenna is that opposite to your lead-in. In your case it would be from the north.

A. 2. A rectified current can be used for operating a D. C. radiophone arc, but the results obtained by using this arc with a rectified current would not be very satisfactory, owing to the fact that the condenser would be unable to charge properly and thus the message at the receiving station would not be very clear.

Audion Detector.

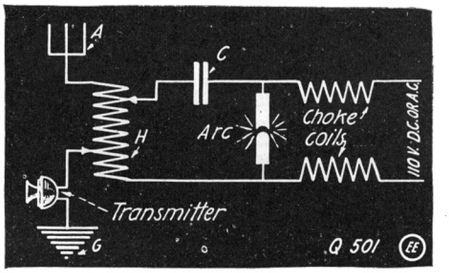
(499.) F. W. Jones, Clatonia, Neb., is interested in building a rheostat for reducing a 110-volt alternating current to the proper voltage for operating an Audion detector.

A. A rheostat can be built for cutting down the voltage. The resistance material can be either of German silver or carbon. We would say, however, that the Audion will not work if an alternating current is used for operating it, but if 110 direct current is employed the reduced voltage can be readily used in operating this detector.

Carbon Filament Used in Electrolytic Detector.

(501.) Vernum Stevens, Kingston, Pa., wants to know: 1. Whether the carbon filament of an electric bulb can be used in an electrolytic detector instead of the platinum wire? 2. Whether the hook-up shown in the question 387, page 437, of the December, 1915, issue, can be used advantageously for wireless telephones? 3. A hook-up showing the substitution of a microphone for the telegraph key in a Poulsen arc circuit.

A. 1. The carbon filament from an electric bulb can be used instead of the platinum wire in an electrolytic detector, but much better results are obtained by the use of the latter.



Wireless Telephone Hook-up for Arc Generator

A. 2. The diagram given in the article which you mention can be used for wireless telephony.

A. 3. The illustration herewith shows the substitution of the microphone for the telegraph key.

Dynamo Query.

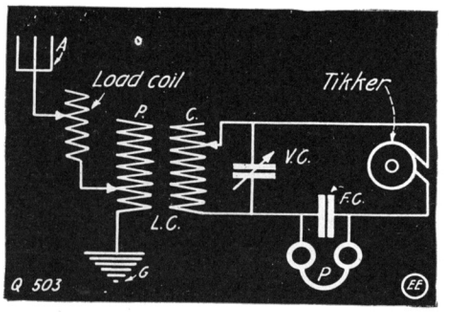
(502.) H. L. Allen, Jr., Arctic Center, R. I., sends us a sketch of his dynamo field and armature, about which he would like to know: 1. The size and quantity of wire necessary for winding the field and armature coils. 2. Whether to connect shunt or series to run it on rectified A. C.?

A. 1. A No. 24 copper magnet wire should be used in winding the armature coils, while No. 20 copper magnet wire should be used in winding the field.

A. 2. The machine should be connected in series.

Tikker.

(503.) James B. Smith, Kansas City, Mo., wants us to give him: 1. The directions and diagram for building a simple, efficient variable condenser. 2. The connection for the following instruments: Loading coil, loose coupler, variable condenser, tikker, small fixed condenser and 2,000-ohm 'phones. 3. Whether galena can be employed instead of silicon in building a tikker?



"Tikker" Hook-up for Undamped Waves

A. 1. We would advise you to look through some of the back numbers of *The Electrical Experimenter*. In several of these you will find sufficient data for building such a condenser, which will no doubt meet your requirements.

A. 2. The illustration herewith shows the connections for the instruments you specify.

A. 3. Galena can be used instead of silicon in the construction of a tikker, but it is harder to keep it adjusted.

D. C. Dynamo.

(505.) Frank Kohyn, Moline, Ill., asks: What amount of wire is necessary to wind on the armature, diagram of which was submitted to construct a dynamo producing 10 volts and 5 amperes, and also the amount of wire necessary for the (series) field coils accompanying the armature?

A. The armature should be wound with 250 feet of No. 26 B. & S. copper magnet wire, while the field coils should contain 450 feet of No. 24 B. & S. copper magnet wire.

Lightning Switch.

(506.) Harold C. Booth, Mass., writes: 1. What is the danger encountered with aerials? 2. Is lightning switch necessary for protecting antennas which are located in the country? 3. Is it necessary for the Underwriters' inspector to inspect the station if a lightning switch is installed?

A. 1. The danger with aerials depends entirely upon the height and location of

(*Continued on page 48*)

ELEVEN Good Reasons For Electro-set Popularity

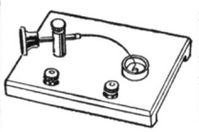
REASON NO. 1

Our Fixed Condenser

A handsome mahogany finished instrument, excellent for detector and phone circuits in wireless receiving sets. The capacity has been carefully calculated making this important piece of apparatus unusually efficient. A high grade instrument at a surprisingly low price..... **40c**
No. 1676 Fixed Condenser, shipping weight 4 ounces.

REASON NO. 2

A "500 Mile" Wireless Detector— Composition base.



When you receive this clever detector, you'll quickly forget that you only paid 40 cents for it. We freely claim it to be as sensitive and complete an instrument as ever produced at anywhere near the price. All metal parts are of brass and highly nickel-plated. The composition knob is generously proportioned, and the arrangement for adjustment is efficient and unique. We have "heard" 500 miles on the detector. Genuine moulded hard rubber composition base. 500 Mile Wireless Detector, complete with phosphor bronze cat whisker..... **40c**
Shipping weight 4 ounces.

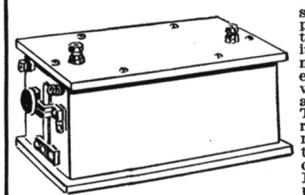
REASON NO. 3

ELECTRALLOY A NEW DEPARTURE IN CONDENSER FOIL

You've endured the poor qualities of tin and lead foil long enough in the making of your condenser. Now comes the Electro-Set Co. with Electralloy, so much superior to the old condenser foils that there can be no comparison. Electralloy is lighter, but stronger, does not crinkle up and is much easier to handle and apply. Electralloy comes in ribbon form, six inches wide. You'll recognize extraordinary qualities when you use it. Best of all, the price is moderate.
ELECTRALLOY..... **2c per foot**
Not less than 10 feet sold. Postage Prepaid.

REASON NO. 4

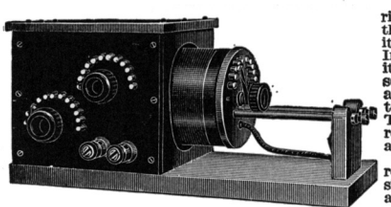
Our 1/8 Inch Spark Coil



We designed and produced this miniature spark coil in response to a demand from experimenters everywhere. Notwithstanding the low price at which we offer this coil, it is very carefully made and presents a most favorable appearance. Our coil is encased in a nicely finished oak box, the vibrator is of the French adjustable type, and the insulation is of most superior quality. The spark is hot and invariably longer than rated. The dimensions of the entire instrument are 6 x 2¼ x 2½ inches. You'll find this coil handy for use about the laboratory or for small wireless sending stations. Price of ⅛ inch spark coil, complete as described..... **$1.50**
Shipping weight 2 pounds.

REASON NO. 5

Our "Navy" Loose Coupler



We are justly proud of this rich appearing instrument and the low price at which we offer it to Experimenter readers. In the limited space available it is difficult to adequately describe this "Navy" Coupler and the picture does poor justice to the detail of its construction. This coupler should meet the requirements of even the most advanced experimenters.

The primary "turns" can be regulated one at a time by a simple rotary motion. This action is accomplished by two generous hard rubber composition knobs with spring brass contacts which pass over a series of switch points. The first series *roughly tunes* ten turns per point. The second series roughly tunes in one turn per point. Probably the greatest merit of our Navy Coupler is the careful workmanship embodied in its construction. All joints are carefully soldered and everything else is done in a painstaking manner.

The woodwork is beautifully finished in mahogany, all metal parts are of brass, gold lacquered. Dimensions, 1 foot x 6 x 5½ inches. The equal of this receiver can not be found at anywhere near our price. It is the acme of efficiency at a moderate outlay. Price as described..... **$9.00**
Shipping weight 5 pounds.

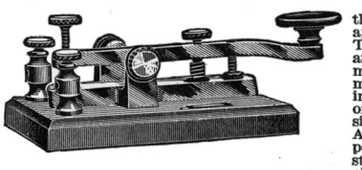
REASON NO. 6

Our Arlington Tested Minerals

It remained for the Electro-Set Co. to standardize the wireless mineral. No longer do you have to purchase "A Cat in a Bag" when you buy this most important portion of your receiving equipment. Electro-Set minerals are tested for Arlington by experts. Each crystal comes individually packed and sealed in a wooden box. Each crystal is guaranteed genuine Arlington Tested by the President of our Company.
Arlington Tested Silicon, prepaid..... 25 cents per crystal
Arlington Tested Galena, prepaid.... 25 cents per crystal
Arlington Tested Zincite Couple, prepaid.....50 cents per crystal

REASON NO. 7

The Electro-Set Special Wireless Key



You'll literally fall in love with the action of this key and its sturdy appearance will delight your eyes The metal parts of this instrument are made entirely of brass. It is mounted on a *genuine* polished marble base. It is especially strong in construction. The contacts are of hardened coin silver of *No. 4* size, easily removable for renewal. All metal parts are lacquered and polished. This key is built for stations from ¼ to 1 K. W. capacity and should last a lifetime with proper use. Size over all, 3 x 6 x 2 inches. Our extremely low price for this key is..... **$3.00**
Shipping weight 3 pounds.

REASON NO. 8

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We have obtained another quantity of the popular ¼ inch spark coil secondaries. They have been used before, but are in good condition. *Two of them will give a ½ inch spark.* They represent very remarkable values at the low price of..... **30c**
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$11.00 Guaranteed Amplifier Coils $11.00

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Superior Radio Apparatus

for every dollar's worth purchased

Send 10c. for our complete catalog.
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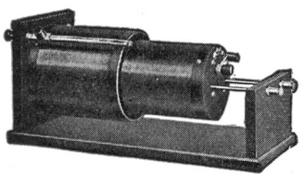
REPAIRS—9 XE—SUPPLIES WIRELESS

We repair all wireless instruments.
Tell us your troubles—no charge.

Get acquainted with our line of Clapp-Eastham apparatus. Let us tell you how to read German Stations on a 100 ft.-aerial, using Resco Inductances.

9 XE-WIRELESS REPAIR & SUPPLY COMPANY
DAVENPORT, IOWA

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $4.50



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Rotary Condenser, 43 plates, .001 M.F., $3.75
Tuner, $2.50. Spark Gaps, 60c. and $1.00
Detectors, $1.00, $1.75, $4.00
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Agent for A. W. Bowman & Co., Adams-Morgan Co. Manhattan Spark Coils. Catalogue for 2c. stamp.

M. MUELLER, 18 Devonshire Street, BOSTON, MASS

BOOST
THE ELECTRICAL EXPERIMENTER to your friends. It will make the magazine better.

QUESTION BOX.

(Continued from page 46)

your antenna. Invariably they must be thoroughly grounded during thunder storms. We would advise you to read over a treatise on lightning, which will undoubtedly give you reasons for the danger from lightning in connection with antenna. The best treatise on the subject that we know of is the one published in the April, 1916, issue of *The Electrical Experimenter*. Ordinarily radio antennae serve the same purpose as lightning rods on a house. The antenna must, however, always be grounded during electrical storms to afford this protection. A No. 4 copper wire, run in as direct a line as possible should be used for grounding.

A. 2. Yes. Use a 600 volt, 100 ampere S.P.D.T. knife switch.

A. 3. If you expect to obtain fire insurance, you are advised to communicate with the Underwriters, so that they can inspect your antenna lead-in and lightning switch if they so desire and thus do away with any trouble in collecting insurance should a loss by fire occur. There is no charge for this.

Magnetic Detector.

(507.) Percy Vettel, Cal., asks: 1. Will a magnetic detector receive undamped wave stations without additional equipment? 2. What size and how much wire is necessary for the construction of a five thousand meter receiving variometer? 3. What is the best method of constructing loading coils for receiving extra long wave length stations?

A. 1. A magnetic detector can not under any circumstances receive undamped waves, especially from long distance, but will undoubtedly receive waves emanating from such stations when they are very close to the receiving station.

A. 2. In building this five thousand meter receiving variometer, it will be necessary to obtain two tubes, one 8 inches in diameter by 4 inches in width, and the other 7 inches in diameter by 4 inches in width, and upon each wind a single layer of No. 20 S.C.C. magnet wire. The windings should be wound in opposite directions so that the magnetic effects are counteracting each other when in operation.

A. 3. The best way in which to build these long wave loading coils is to wind a single layer of insulated copper wire upon an insulating tube, either of cardboard or hard rubber, preferably the latter as there is less chance of shrinkage.

Perpetual Motion.

(508.) Edwin Ebel, Spokane, Wash., writes: 1. Can you account for a continuous humming in an incandescent light bulb which is located at some distance from my wireless room? 2. Is there any way to eliminate the induction in the receivers of a wireless set? 3. When a dynamo and motor are connected together can they be used for a perpetual motion machine if the dynamo is first started?

A. 1. One reason which might be the cause of the continuous humming of the incandescent bulb is that the filament of the electric lamp is set in resonance with the transmitter, and thus it produces a vibration in the filament which, in turn, causes the humming. Of course, if the filament is operated on a D.C. circuit the humming may not be due to the wireless transmitter, but possibly to the change of vacuum in the bulb and by the rapid changing of the current of the dynamo. It is well known that the current produced by a direct current generator is not purely direct, but pulsatory. Thus it is evident that the filament would be caused to vibrate very fast on account of these currents. It might also be due to the vibration of the building causing the filament to oscillate. However, this is not likely, but one of the first two reasons cited is most probably the cause of the phenomenon.

A. 2. The only means by which you can overcome the induction in the receiver is to change the position of the service mains so that they are at right angles to the receiving wires. If this does not help, place parallel wires between the current mains and connect same to the ground so that the inductance effect may be removed from said conductors and thus eliminate the humming effect.

A. 3. The scheme which you suggest has been tried a considerable number of times, but it always fails on account of the fact that you can not produce power without losing some. We would advise you to familiarize yourself with an article on perpetual motion which appeared in the January issue of *The Electrical Experimenter* on page 478. This article clearly elucidates the reasons why such a device can not work.

Smoke Eliminator.

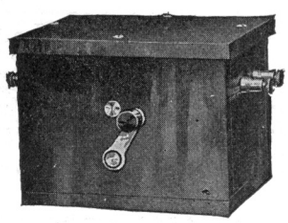
(509.) J. C. Grabbs, Toledo, Ohio, inquires: Where can I obtain more information on the subject of electrical smoke elimination about which there was an article published in the March issue of *The Electrical Experimenter?*

A. We would suggest that you communicate with the Research Corporation, 63 Wall Street, New York City, from whom you can obtain all the necessary data, as this company is practically the only one in this country where you can obtain accurate information on this subject.

Current for Spark Coil.

(510.) Daniel Rowlands, Ogden, Utah, asks: 1. How many dry cells are necessary for operating a 1½-inch spark coil? 2. Will an ordinary lighting current burn out this coil? 3. What device is necessary to eliminate the sparking between the vibrator contacts of an induction coil?

THE AUDIO-ROTOR
For Undamped Wave Receiving



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SIMPLIFIED WIRELESS TELEPHONE
Transmitting and Receiving

We have a series of twelve hook-ups for your bulb receiver, showing methods of amplification and practical directions for wireless telephoning with it. All blue printed, suitable for framing, with your name.

Per set, 50c postpaid

RICHARDSON COMPANY, Commerce Building **ERIE, PA.**

A. 1. The number of cells required for operating a 1½-inch spark coil successfully is about eight. However, far better results can be obtained if storage batteries are used instead of dry cells.

A. 2. If you do not use a resistance in series with the coil you will certainly burn out the coil, but if you prefer to operate the coil on lighting current you will require a resistance box, or better, an electrolytic interrupter, which should be connected with a choke coil so that the maximum results can be obtained.

A. 3. The only way in which to reduce the sparking at the vibrator contacts is to shunt a large capacity condenser across the two terminals of the vibrator. The size of the condenser will depend upon the size of the coil. It may be made of tinfoil and paraffined paper.

Dynamo Winding.

(511.) C. Satterlee, S.D., writes: How much and what size wire will be required to wind the armature and fields to make a shunt wound, 6 volt, 4 ampere dynamo?

A. It will be necessary for you to wind the armature with about 200 feet of No. 26 copper magnet wire, while the field coils should be wound with 300 feet of No. 28 copper magnet wire.

Changing Open to Closed Core Transformer.

(512.) Edward Law, W. Va., asks: 1. How can I receive undamped waves with the following instruments: aerial, loading coil, loose coupler, two variable condensers, audion (type R.J. 4), fixed condenser and 3,000 ohm 'phones? 2. Does Key West (N.A.R.) send the weather reports as soon as Arlington (N.A.A.) quits? 3. Can an open core transformer be converted into a closed core type?

A. 1. The only means that you can employ to receive undamped waves is to make your audion oscillate and to do this it will be necessary for you to change the standard audion circuit to an oscillating circuit. If you will peruse some of the recent numbers of *The Electrical Experimenter* you will find several oscillating audion hookups given, which will be just right for your instruments.

A. 2. N.A.R. sends weather reports as soon as the government station at Radio, Va., stops.

A. 3. An open core transformer can be converted into a closed core type by removing the secondaries from the open core and by converting the said core into a closed one, and then placing the secondaries over one leg of the "closed core" and the primary on the opposite leg. However, the efficiency will not be as great as if a closed core is first built on account of the different dimensions of the windings that are required in the closed core design.

Wave Length in the Day Time.

(513.) John Doe, Racine, Wis., writes: 1. Does the wave length of a station differ in length at different times of the day? the energy in the wave? 2. How can I obtain a license for operating a transmitter of over 200 meters? 3. Will a wireless wave pass through water?

A. 1. The wave length and energy of an antenna when sending at different times of the day does not change to any extent that is noticeable, but the wave length of any antenna may change somewhat during the summer months, as the capacity between the elevated wires and the ground changes, due to the different value of the dielectric; that is, during the summer the atmosphere is

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"My range with Crystaloi is over 5000 miles. On Dec. 19th I plainly heard KMG & KMF in Alaska, a distance of over 3,800 miles.
(Signed) A. L. Groves, Brooke, Va."

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Is Giving Complete Satisfaction to Over 10,000 Users

Crystaloi is unlike any other detector on the market. It is the only detector affording innumerable contact points. The arrangement of mineral and finely divided alloy is such as to render it remarkably free from static and other interferences.

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TYPE O—Dimensions 2¼″x1⅞″.
Price, $3.50. Mailing Weight, 1 lb.
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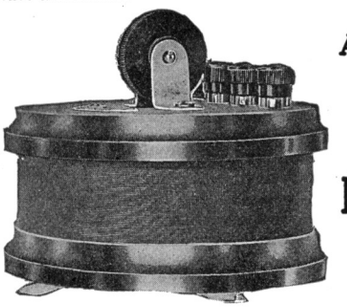
TYPE BB—Equipped with cohering inductance, fixed condenser, buzzer, test and frequency control. Dimensions, 7½″x 5½″x3½″.
Price, $12.00. Mailing Weight, 4 lbs.



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If your dealer cannot supply you, write us. Catalog "C," fully describing Crystaloi and all of our other High-Class Receiving Apparatus sent on receipt of 5 cents in stamps.

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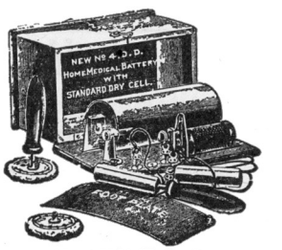
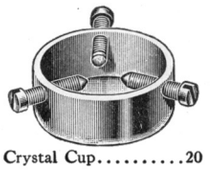
GET ACQUAINTED WITH THE GOODS THAT LAST

Switch Points.
Brass....05
Nickel..07½

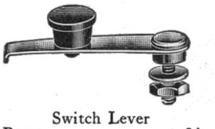


No. 4 HOME D. D.
MEDICAL BATTERY $5.50

Switch Points.
Brass.....03
Nickel...04½



Crystal Cup.....20



Switch Lever
Brass.....24
Nickel.....30

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AT PRICES BELOW COST OF MANUFACTURE

NOTE—This important announcement is rushed to readers of the Experimenter, and just reaches the press in time for publication in this issue.

We have just purchased a splendid special lot of new, vulcanized black fibre, cut to three sizes, polished edges, perfect goods. This fibre was manufactured especially for foreign trade—war conditions prohibited its export. We were fortunate in securing 1¼ tons of this fine material at extremely low prices. We offer it to Experimenter readers, as long as it lasts, at prices below manufacturing cost.

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Size 1—Square Rods..... ⅝ inch x ⅝ inch.....3 foot lengths
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Cut to any length *over* 1 foot. Not less than 25 cents worth sold.

PRICES	Regular Price	Our Price
Size 1— ⅝ inch square, per foot	$0.45	$0.16
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Size 3—5/16 inch x 2 inches, per foot	0.90	0.30

Shipping Weight: 1 pound for 2 feet.

USES

Every experimenter will find countless uses for this high-grade fibre in such splendid sizes. The sizes are ready cut for dozens of applications.

Size 1: Useful for insulating standards, making of helices and oscillation transformers, posts, handles and crossbars on antenna switches, and other switches, strain insulators, aerial insulation, detector supports, spark gap standards, etc.

Size 2: Useful for connecting blocks, switch cross-bars, strain and aerial insulators, detector use, pancake tuners and oscillation helices (as wire supports) and countless other uses.

Size 3: Useful for detector bases, connecting blocks, instrument supports, instrument bases, switch bases, ground switch bases, rotary gap uses, high frequency coil applications and general experimental use.

This fibre is an especially fine grade with highest dialectric value and great tensile strength. Cut into 6 to 12 inch lengths, and coated with vaseline or paraffin, it makes *very efficient antenna insulators*, with great strength and efficiency.

We have a large quantity of this fibre, but it will go fast. Better order today. Anticipate your needs since this unusual opportunity will never present itself again.

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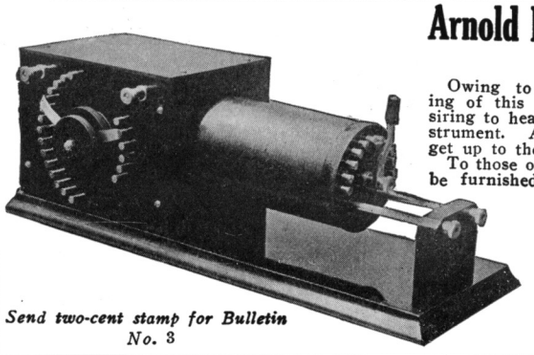
The Electro-set Co. **1874 East 6th Street CLEVELAND, O.**



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Arnold Navy Type Loose Coupler

PRICE, $15.00

Owing to the peculiar construction and winding of this instrument it is possible for those desiring to hear the Arc Stations, to do so on this instrument. A special Hook-up is needed in order to get up to the wave length.

To those ordering an instrument such Hook-up will be furnished gratis.

It is as in the past the Right instrument to do all first class receiving with. Workmanship and material the best.

Send 2-cent stamp for Bulletin No. 8, which describes fully, also shows the finest line of Switch points, Rubber knobs and accessories on the Market.

J. F. ARNOLD
135 East 119th Street, New York City

strongly ionized on account of the sun's rays and thus if the dielectric is altered the capacity is also changed and therefore the wave length. This change of wave length is not very noticeable and is not taken into consideration in transmitting radio messages ordinarily.

A. 2. The only way to obtain a license for operating this transmitter is to write to the Radio Inspector of your district, asking him to give you a license for operating a transmitter of over 200 meters wave length.

A. 3. Wireless waves can penetrate every insulating substance known and therefore will pass through water.

Electrical Engineers.

(514.) William Warnecke, Jr., New York City inquires: Through what stages and how many must a person pass to become an electrical engineer?

A. It is impossible for us to go into details in this department regarding all the various stages that one has to pass through in order to become a professional electrical engineer, but, however, we here state several of the most important ones. The first thing that an engineer has to have is a complete knowledge of pure and applied mathematics, starting with simple arithmetic and including analytical mechanics and differential equations; second, a complete knowledge of physics, chemistry, drafting, thermodynamics, materials, structures, hydraulics, the various electrical subjects such as direct and alternating currents, electric traction, transmission, distribution, telegraphy and telephony, etc. If you are particularly interested in the time period required for completing each of these subjects, we would advise you to write for information on them to an engineering school or college of which there are several in New York City. They will gladly give you all the details that you may desire. Also refer to the electrical schools listed in our advertising columns.

Radio Receiving Range.

(515.) John Burton, Richmond Hill, N.Y., asks: 1. What is the receiving range of a set consisting of tuning coil, galena detector, Crystaloi detector, fixed condenser, variable condenser and 2,000 ohm 'phones in connection with aerial 50 feet long and 40 feet high, consisting of 4 copper wires? 2. What is the maximum wave length of this set? 3. What size loading coil should be used to tune to Arlington, Va.?

A. 1. The maximum distance that you can receive with these instruments would be an average of 800 miles.

A. 2. The maximum wave length which you can obtain with this set would be 2,500 meters.

A. 3. A loading coil which will tune this station can be constructed by winding No. 24 B. & S. copper magnet wire on a cardboard tube 14 inches long and 3½ inches in diameter.

Receiving Without an Antenna.

(516.) Fred Shelton, Seattle, Wash., writes: With the set and the connections which I show in the accompanying diagram is it possible to receive messages without an antenna?

A. There would be no trouble in receiving messages with your set without an antenna at short ranges from a powerful commercial station. You can increase the range of reception without an aerial, by connecting the end of the loading coil to a metallic object which is not grounded in any way. Bed-springs have often been used advantageously as a capacity for receiving radio signals without an aerial. Connections to gas and water pipes often give good results also.

Tone Wheel.

(517.) Harry S. Paine, Pa., asks: 1. Why is it not necessary to employ a tone wheel detector for receiving the undamped waves emitted by the Arlington Station? 2. Can Sayville and Tuckerton be picked up with an ordinary detector? 3. Why is it that Arlington signals come in louder with an ordinary tuning coil and loading inductance than with a loose coupler?

A. 1. The reason is that Arlington employs a somewhat semi-damped transmitter, but if a tone wheel is used in connection with a detector the signals are found to be stronger than with an ordinary detector. It has been found that by using an oscillating audion the strength of the signals are considerably increased.

A. 2. It would be impossible for you to receive Sayville and Tuckerton with an ordinary detector, unless some sort of tikker device is employed in connection with the detector.

A. 3. The reason for the strength of the signals being increased when using a loading coil is that the efficiency of a loose coupler is not as great as that of the tuning coil, due to the fact that the weak currents are reduced by the transformation of the primary current to the secondary winding by induction through an air core.

Lightning Switch.

(518.) Burton Davis, Detroit, Mich., writes: 1. Can a 50 ampere D.P.D.T. switch be used for grounding an aerial and yet be in compliance with the Underwriters' rules, providing the two levers are connected in parallel? 2. Do iron screws affect the operation of wireless receiving sets?

A. 1. You can use the switch if the two levers are connected in parallel for a lightning switch.

A. 2. Iron screws have an untoward effect on the operation of receiving instruments, especially when the instruments are connected with an oscillating audion. This is due to the fact that iron increases the impedance of alternating current circuits, thus the effects are reduced. However, if iron screws are employed in ordinary receiving outfits almost no magnetic effects are noticeable.

½ H. P. Dynamo.

(519.) Ward Ingersoll, Minn., asks: 1. How can a ½ H.P., 110 volt D.C. motor be used as a dynamo? 2. What would be the probable voltage capacity in lights and the approximate speed of such a dynamo? 3. Is dry, white oak suitable for use in constructing a switchboard?

A. 1. Drive the armature at the rated speed of the machine. Reverse the rotation if it does not build up properly or excite field winding for a few minutes from the current supplied by a few dry cells.

A. 2. The probable voltage developed by this dynamo would be about 110 volts D.C. and the number of tungsten lamps that it can light would be 13 of the 110 volt, 25 watt type. The necessary speed at which the machine must run would be approximately 1,400 R.P.M. (as near as we can tell from data submitted).

A. 3. This material is suitable for constructing a low voltage switchboard, but if it is to be used on higher voltages than 50, we would advise you to build it of slate or marble.

Using Well for Ground.

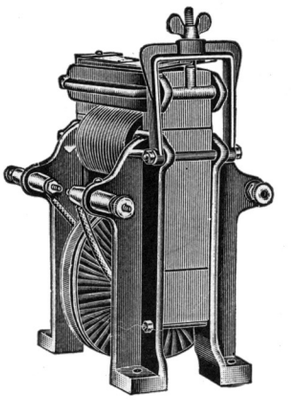
(520.) Meredith Hendricks, Illinois, inquires: 1. Can the Western Union Telegraph Company stop me from using a 600 meter radio receiving set when my aerial wires are placed 20 feet from their wires?

TUNE UP!

Make your spark *stronger* and *steadier* and your wireless apparatus *200% more efficient* with a

THORDARSON

WIRELESS TRANSFORMER



YOUR wireless set will immensely increase its sending capacity—transmit hundreds of miles further—if you have a THORDARSON Wireless Transformer. Standard wherever wireless transformers are used. Amateurs in all parts of the United States are getting better results—surer, more reliable results, with the THORDARSON. Superior design and quality materials make it a leader—a real necessity for practical wireless operators.

Perfect In Every Detail. The THORDARSON connects direct to the alternating circuit. No Impedance or Choke Coils needed. Constructed with magnetic shunt regulating device, giving instant adjustment of current, **while the THORDARSON is in operation.**

The Magnetic Shunt makes the THORDARSON practically a constant current transformer. Variation can be effected **without disconnecting the transformer or cutting off power.** This is a big advantage in sending; saves much time in tuning up; enables you to change from station to station without getting "out of the game."

Lower Cost. By the magnetic shunt the THORDARSON achieves the same result of **constant current,** effected in the big commercial stations by the use of an open core transformer. Yet the **THORDARSON costs less than half as much** and has a much lower current consumption **Less Current.** When the THORDARSON is short-circuited it does not pull an excessive amount of current. Consumes no more power than the magneic shunt is set for. Simply turning thumb screw increases the power of capacity. No bolts and nuts to loosen or remove.

Wonderful Flexibility of the THORDARSON makes it possible to obtain perfect balance—a resonant condition. It will make your sending clearer and more distinct, at greater distances.

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THORDARSONS Are Air Cooled Assembled in heavy black enameled iron frame, shunt yoke adjustment in cast brass. Secondary terminals of polished hard rubber with brass core, for easy adjustment. Windings thoroughly insulated from each other. ½, ¾ and 1 KW. capacity standard winding for 100-120 volts, 60-133 cycle. Special winding extra.

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Thordarson Electric Mfg. Co., 506 SO. JEFFERSON STREET CHICAGO

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EFFICIENT EQUIPMENTS FOR ALL PURPOSES

MIGNON-SYSTEM RADIO-APPARATUS

MIGNON WIRELESS CORPORATION
ELMIRA, N.Y. U.S.A.

DAMPED & CONTINUOUS WAVES

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MIGNON TRANSMISSION CONTROLLERS

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Radio Apparatus and Supplies
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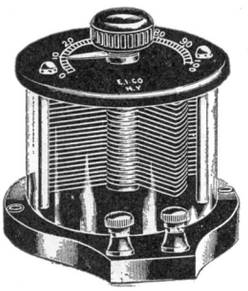
Make Your Own Electric Current
Anyone with engine can operate generator Don't pay electric bills. No special skill required to install or operate 30-50-100 light sizes. Special unit Charges Auto-Starting and Lighting batteries. Movie Arc dynamo furnishes economical D. C. right for Arc.
ONLY $10 GIVES YOU ONE OF THESE MACHINES
the balance in small monthly payments
HOBART BROS., Water St., Troy, Ohio

Chicago Wireless Headquarters



CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.

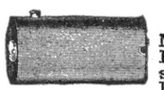
ROTARY VARIABLE CONDENSERS

Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75

No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....65c.
Extra battery....20c. Extra bulb....15c.

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....85c. 100 Watt.....90c.



No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....45c.
Extra bulb, 15c. Extra battery, 20c.

FINE 50c. POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for 25c.), or each 15c. New Flints, 5c. 6 for 25c.

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

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NEW WIRELESS WONDER

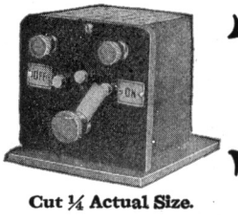
THE INSTANT RADIOGRAPH

Greatest invention of the age. The result of years of experimentation.
Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages
Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

YOU CAN RECEIVE INSTANTLY WITHOUT ANY ADJUSTING

3,000 miles is latest record of the Instant Radiograph.
It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.
Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

INTRODUCTORY PRICE FOR APRIL $3.00



Cut ¼ Actual Size.

The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.
The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and high, binding posts are made of non-corroding metal, heavily silver-plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver-plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be proud to have in your wireless station.**
The Radiograph is the greatest recent invention in the wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalogue A of the Instant Radiograph.**
Here's a book—a book you need. "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.
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DO NOT BUY a bicycle, tires or sundries, until you write and learn what we will do for you. A postal card brings everything—write it now.
MEAD CYCLE CO., DEPT. H, 107 CHICAGO

2. Can I ground my antenna in a well thirty-five feet deep and will it be better than if grounded to a copper plate buried in the ground?

A. 1. This company can not under any circumstances stop you from using your 600 meter receiving set, as the receiving set has absolutely no effect on their instruments.

A. 2. Your antenna can be satisfactorily grounded to the well and it will be more efficient than if connected to a copper plate buried in the ground, providing the well always contains water.

Radio Operator.

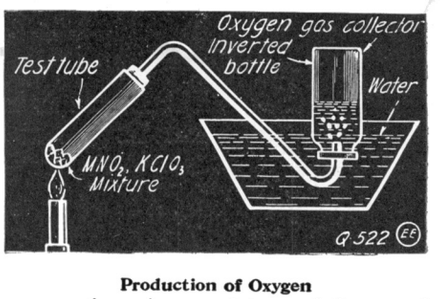
(521.) James B. Pendleton, Kans., asks: 1. How may I prepare to be a radio operator and what opportunities are there for a person entering this field? 2. Please give a list of the best radio schools, both commercial and private, and a number of books which cover the subject.

A. 1. In order to become an expert wireless operator, it is necessary for you to become familiar with the radio codes, the technique of the various wireless and allied apparatus and you must also be acquainted with the government laws in regard to this subject. As to the opportunities offered by this profession, a young man has very good chances of seeing the world, while earning a livelihood. Operators on land are paid more than those at sea, but the higher living expenses on land make the salaries about equal. This field at present is still in its infancy and the various commercial companies in this country and abroad are very anxious to obtain the services of young men for radio operating. There is no doubt that the field of radio telegraphy is growing every day. There are good chances for advancement.

A. 2. We suggest that to obtain a list of good radio schools you glance over our advertising columns and you will undoubtedly find the information you desire. It would be impossible for us to give a list of books on this subject as there are a large number of technical and practical publications available. If you desire such a list we would suggest that you write to the Book Department of The Experimenter Publishing Company, 233 Fulton Street, New York City. You might also communicate with the Navy Department Washington, D.C., and they will send you full information regarding the wireless department of the Navy and naval books available.

Oxygen Generator.

(522.) Herbert Englert, Okla., asks: 1. Why do I have trouble in generating oxy-



Production of Oxygen

gen gas by using a mixture of 1 part of oxid of manganese, 3 parts of chlorate of potash. 2. How shall I rewind a 9 volt, 4 ampere shunt generator so as to generate about 12 volts, 5 amperes?

A. 1. The only reason for your not obtaining the oxygen gas from your mixture is that the apparatus is not correctly assembled. Herewith is given the correct position of the apparatus, which will readily generate the said gas from the mixture which you have used.

(*Continued on page 54*)

New 1916 Edition Wireless Manual A9

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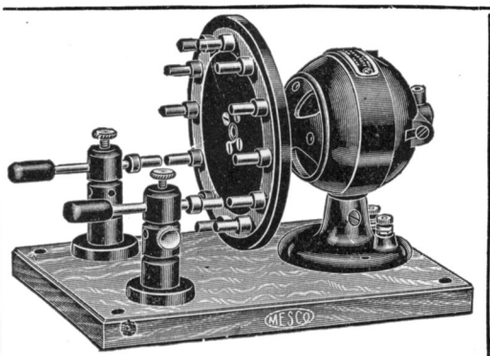
New diagrams. New matter. Everything brought up-to-the-minute. Most complete Manual as well as list of up-to-date, reliable wireless goods. We manufacture a lot ourselves and handle the very best that others make.

Our Pocket Electrical Catalogue W28, 248 pages, mailed on request. This catalogue contains practically everything in general use in the electrical line and is in fact a small pocket encyclopedia of electrical goods information.

EVERY ONE SHOULD HAVE A COPY OF BOTH



Mesco Rotary Spark Gap

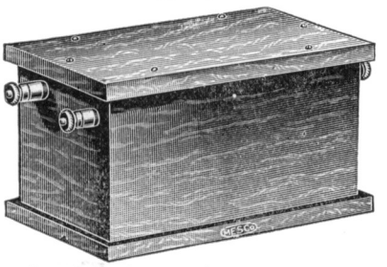
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes for 3/16 in. shaft	5.00

Mesco Intensifying Transformer

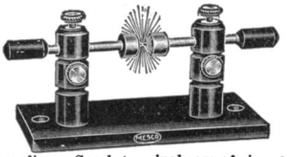


Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

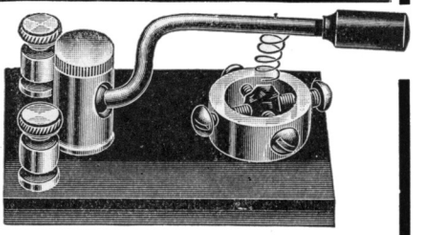
Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$2.80

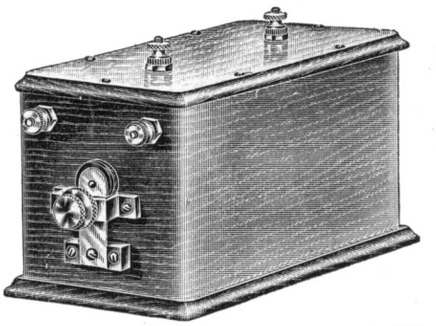
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

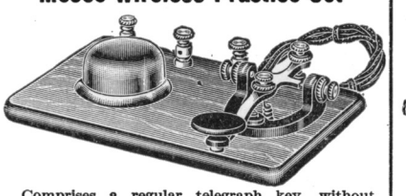
Mesco Wireless Receivers

Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 1000 ohms each	$6.00

Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

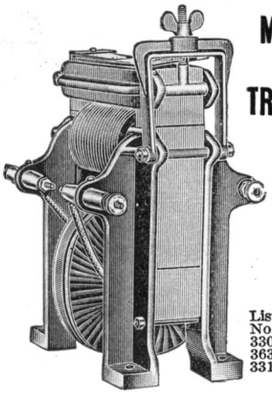
List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.88

Wireless Key

This key is of the Standard type of telegraph key, but with no circuit breaker and with extra heavypoints. The bushings are of mica, which will stand the heat caused by breaking heavy currents. This key will break as much as 25 amperes if shunted by a suitable condenser. Can be used on stations from the smallest up to 2½ K. W. capacity. Points renewed at twenty cents per point net, if key is returned to us.

Steel lever is nickel plated, and brass frame is finely grained and lacquered.

List No.		Price.
452	Nickle plated lever, brass frame	$1.80
453	Full Nickel Plated	1.95



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity. k.w	Secondary Voltage.	Price.
330	½	5,000 v.	$15
363	¾	10,000 v.	20
331	1	20,000 v.	25

Manhattan Electrical Supply Co.,

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A Continuous and Cheap Service of ELECTRIC LIGHT

In Your Country Home, Hotel, Club, Church Institution or Small Town

You simply switch on or off your lights and the

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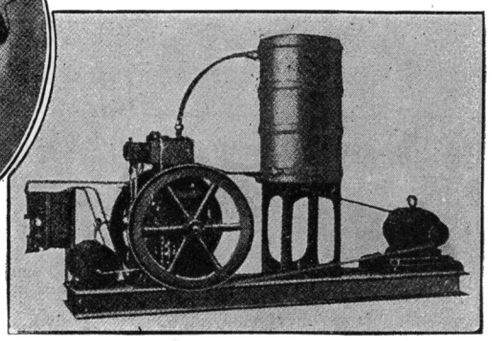

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THE BRUSTON AUTOMATIC ELECTRIC LIGHTING PLANT gives you the same continuous service of light and power in your country home, hotel or institution as you have in the City of New York.

The plant is absolutely automatic, starts itself, regulates itself and stops itself. Practically the only attention required being to fill the fuel and oil tanks.

It will generate current at less than half what it would cost you in the city.

This plant has obtained the highest awards at the leading expositions in England, Canada and France, has been installed in the houses of many of the leading people of the world and has never been replaced by another plant or taken out as unsatisfactory.

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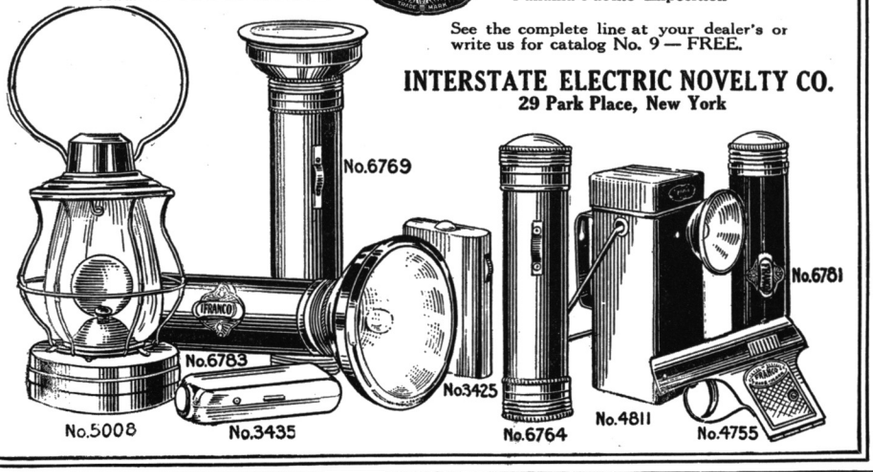


QUESTION BOX.

(*Continued from page 52*)

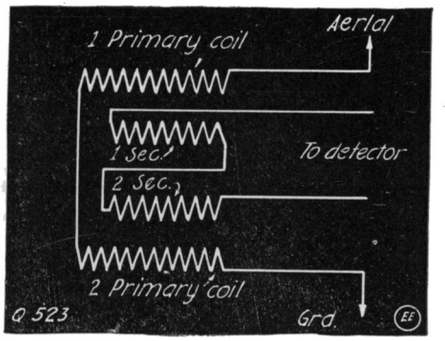
A. 2. It can't be done. You may change your dynamo so it will develop 12 volts and 3 amperes by rewinding the machine; the field coils should be wound with No. 26 B. & S. copper magnet wire, while the armature should be wound with No. 22 B. & S. copper magnet wire.

New Inductive Tuner.

(523.) Albert Upton, Minneapolis, Minn., writes: 1. Will you please give me a diagram of connections for the new "sliderless" type inductive tuner with two primaries and two secondaries, recently described in *The Electrical Experimenter*. 2. Can No. 24 B. & S. copper magnet wire be used for winding the cores of this tuner, or will some other size be better to use for this purpose?

A. 1. The accompanying illustration gives the connections of the two primary and the two secondary coils. The principle is the same as that of the variometer.

A. 2. The No. 24 insulated copper wire can be used to good advantage for winding



Connections of Sliderless Coupler.

this tuner, but we would suggest that if the primary is wound with No. 22 wire and the secondary with No. 24 wire, you would perhaps obtain better results.

"AMERICA'S ELECTRICAL WEEK."

"America's Electrical Week" has been selected by the Campaign Executive Committee as the official name for the great electrical celebration, December 2 to 9, 1916. A start has already been made on the nation-wide campaign, which, from every indication, will surpass even the wonderful results accomplished by the 1915 "Electrical Prosperity Week."

The history and how results were obtained by the different interests during the week of 1915 has been published by the Society for Electrical Development in a most attractive 52-page book entitled "The Story of the Week." The book has been given a complimentary distribution of 25,000 copies. It will be of great value as a guide to local committees during the 1916 campaign.

The name "America's Electrical Week" was chosen this year because of its timeliness, the patriotic thought it conveys, the national aspect the name indicates, its euphony, and its appeal to every citizen. The date is practically the same as that of last year, which was generally conceded to be the best time of the year as it began the Christmas drive for big business.

Considerable deposits of tungsten ores have been found in the Province of Tacna, Chile, and at Llallagua, Bolivia.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

AUTOMOBILE SIGNAL.

(55.) John T. Dwyer, Philadelphia, Pa., has invented an electric tail-light and warning signal. He would like our advice on the patentability and practicability of the device. The contrivance is to be used principally for automobiles, to give warning to vehicles in the rear as to which way the driver intends to turn.

A. Your very clever idea is well suited for automobiles, and we believe there is a large demand for it. It should be possible to manufacture it at a low cost. Inasmuch as it can be attached to the license plate, we think it would quickly find favor with automobile owners. We think the idea is new and patentable, and our advice is to get in touch with a patent attorney at once.

CEILING LIGHT FIXTURE.

(56.) Frederic Petrequin, Ste. Genevieve, Mo., submits an idea on a special ceiling light hanger, and would like to have our answer as to patentability, etc.

A. The drawings and specifications present nothing new. Just because a binding post is used would be no reason for obtaining a patent. We hardly think that a patent could be obtained on the device.

AUTOMATIC CONTACT.

(57.) W. Wesley Miller, Ardmore, Pa., submits a small device that, when connected to a push button, automatically makes two separate contacts, and then automatically returns to its position. It can be constructed so as to make three contacts. He wants to know if there is a special use for a device of this kind.

A. Yes, we think there would be quite a few uses for a device of this kind, providing it could be made cheap enough for certain purposes. In large hotels a device of this kind might be very useful for calling several people on the same floor simultaneously. Without knowing the full details of the invention it is almost impossible to give intelligent advice as to the patentability. This depends entirely as to how the device is constructed, and we suggest getting in contact with a patent attorney and have similar devices looked up.

BURGLAR-PROOF AERIAL.

(58.) Harry Turner, New York City, wishes to know if there is a demand for an article of the kind to let a wireless operator know when his aerial is being taken down by mischievous persons, or else when disarranged by a storm. He also desires to know if an idea of this kind is patentable.

A. No doubt a patent could be obtained on a device of this kind, but we hardly think it would pay the inventor in the end, as there would be a very small market for such an article.

WIRELESS DETECTOR.

(59.) James R. Allen, Des Moines, Ia., submits drawings on a new wireless detector, and would like to know if it would pay him to have it patented. Also if the scheme is novel enough.

A. While a device of this kind will undoubtedly work if placed in a certain position, the use of mercury as a contacting member with a mineral is not practical at all. If the material is submerged entirely the detector will not work. Contact must be kept with the mineral, however, but as mercury shifts its position at the slightest jar, the detector would become inoperative at once. For this reason we do not think the idea is practical.

AUTOMATIC RHEOSTAT.

(60.) H. W. Hermance, Newark, N.J., submits a drawing of an automatic rheostat which he has contrived and he desires to have our advice on this invention.

A. This rheostat is of the compensating type and makes use of air cushion in the regulation of the current. It contains several points of merit, but we would advise the inventor to work out some of the details which do not seem to be perfect in the drawings as submitted to us. We think a patent might be obtained on this invention.

INDUCTIVE TUNERS.

(61.) Philip W., La Jolla, Calif., submits drawings and specifications of an inductive tuner and desires to have our advice on same.

A. The invention is certainly original as far as the coupler is concerned and to our knowledge this construction has not been in use heretofore. The only drawback we can see is that it is rather a difficult matter to place sliders on either the secondary or the primary, but we believe this can be easily obviated by changing the construction somewhat. We think the plan is a very good one and we think that it will work out in practice and that a patent may be obtained on same.

FLASHLIGHT WITH RHEOSTAT.

(62.) William J. Slifer, Quakertown, Pa., has sent in an interesting drawing and description of a flashlight equipped with a rheostat; the idea being that by turning the bottom of the flashlight backward or forward the intensity of the light will be changed. It is obvious that in some cases only but little light is desired or where the full glare of the flashlight is objectionable or undesirable. In such a case a simple dimming device would be welcome. This is the basis of the invention.

A. We think the idea is a very good one and if it can be made to fit an ordinary flashlight without changing same, we think

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention, and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents,** etc.

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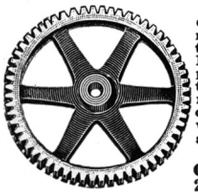

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a valuable patent may be obtained. We do not approve of the method to make a special flashlight as one should consider that most flashlight manufacturers have tied up huge sums in dies and equipment with which to produce their flashlights and most of them are loath to change this equipment to fit any special invention. If, however, the rheostat can be incorporated in existing flashlights, we think there is a good possibility of inducing a manufacturer to market the device.

VACUUM TRANSMITTER.

(63.) W. J. Madole, Nashville, Tenn., has invented a mechanical make and break of high frequency for induction coils, also a vacuum enclosed transmitter for wireless telephony. The inventor wishes to know whether we think the idea is practical and patentable.

A. There is nothing new in the mechanical make and break as described; devices of this sort have been used frequently and besides this they do not work very well. We would discourage this idea as it does not seem practical to us.

The second idea of a vacuum enclosed transmitter is entirely faulty and it is impossible to work it, besides the principle is wrong. By arranging the transmitter as our correspondent suggests, it would be deprived of all the air cooling which is so essential in a transmitter used for wireless telephony where a large amount of current must be dissipated. Also the diaphragm would naturally cave in as soon as the part of the microphone was placed in the vacuum.

TELEPHONE INDICATOR.

(64.) H. E. Beane, Wilkensburg, Pa., submits a copy of a recent patent issued to him on a telephone indicator and desires to know if it is practical and if we see any field for it.

A. The purpose of this department is to advise inventors and would-be inventors as to the practicability of ideas before they have been patented. In our "Patent Advice" we cannot entertain criticisms as to patents actually issued as this would put the columns on a commercial basis, which, for obvious reasons, we cannot do. Once a patent is issued, it, as a rule, becomes a commercial proposition nine times out of ten and for this reason we advise patentees not to use the "Patent Advice" columns for advice and criticisms, but try to market their patents by selling them outright or by developing same themselves.

DOUBLE FIRING GAS ENGINE.

(65.) Henry P. Allmaras, Corona, L.I., submits sketch and description of a double firing gasoline engine and wishes to know if same is practical and can be patented.

A. While we think that a device of this kind can be made to work, to our knowledge it has never been tried and it would be best for our correspondent to make some experiments to find out if this theory is correct. Offhand we would say that the device will work, but whether it will be more efficient than a single firing cylinder we have no means of knowing without making experiments.

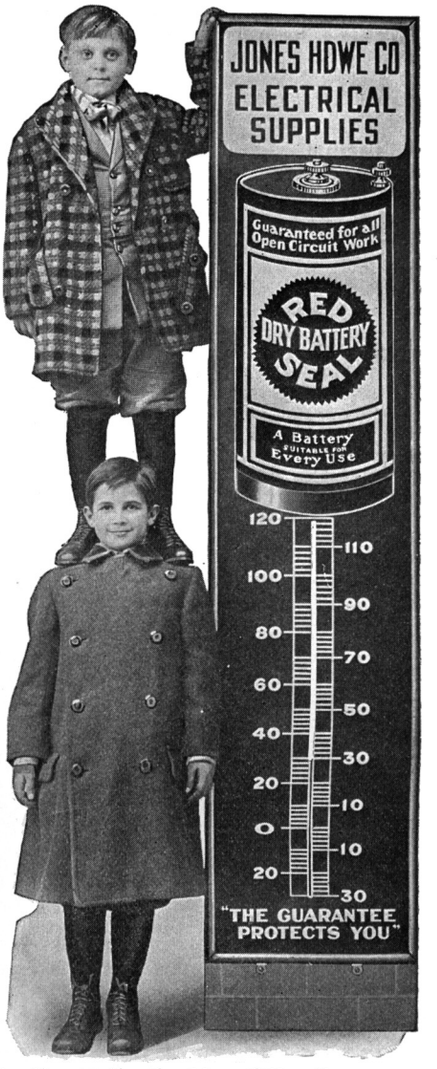
ELECTRO-MAGNET.

(66.) Adrian Schade, St. Paul, Minn., submits drawings and specifications of a special combination of electro-magnets to operate on alternating current. Several means are employed to increase the efficiency of the lifting power. Our correspondent wishes to know if the idea is novel and if a patent can be obtained upon it.

A. We see nothing novel in the idea submitted and we have our doubts whether the arrangement as shown will make the magnet more efficient. As a matter of fact there is an open air gap which has to be bridged by the piece to be lifted, which is not always of soft iron, so necessary for a transformer. We think the efficiency would be decreased thereby instead of increased.

"SOME" THERMOMETER.

A distinctly novel form of electrical advertisement. Two bright looking little chaps, one



standing on the shoulders of the other, convey the height of the thermometer, which is stated to be eight feet.

CUT-OUT.

(67.) A. W. Meyers, Philadelphia, Pa., submits diagrams and description of a cut-out system to prevent storage batteries from discharging back through the generator.

A. Nothing new is shown in the invention and there are dozens of generators on the market working in the manner shown. In the catalogs of most electrical supply houses may be found cut-outs working on this principle.

ELECTRIC FARMS POPULAR.

A few years ago electricity on the farm was a novelty. Today there are any number of farms where electric light and power are available. A complete electric plant can be installed for a few hundred dollars. It is practically automatic in action and requires little attention. It takes up very little room in the cellar and the current can be used to light all the farm buildings, for small heating and cooking devices in the home and for electric fans, vacuum cleaners and other devices.

CAN ELECTRICITY PRODUCE RAIN?

(*Continued from page 7*)

fied and the remainder negatively. Again, the fine drops were always negatively charged while the large ones were found to be positively charged. Several snow squalls occurred while these tests were being conducted and falling snow was invariably found to be negatively electrified or charged. Hail was always positively charged.

The magnitude of the electric charge per cubic centimeter in falling rain was accurately measured and fine rain exhibited a negative value of .24 to .06 electrostatic units per cubic centimeter; rain consisting of large drops indicated an average positive charge of 1.5 electrostatic units per one cubic centimeter.

It is often popularly imagined that the atmosphere reverses or changes its electric charge from positive to negative and vice versa during or directly after rain storms. In the tests conducted by Prof. McClelland and J. J. Nolan, the potential gradient of the atmosphere in several instances was measured. In one interesting test the potential gradient measured 100 volts *positive* charge just before a snow fall occurred. Shortly after it began to snow the potential gradient changed to a *negative* value and the electrometer measured a voltage of 2,500 maximum, which held to this value throughout the storm. On its cessation, however, the potential gradient suddenly changed back again to a normal positive value with a potential equivalent to that existing before the storm.

Normally the earth is negatively charged and the atmosphere positively; thus it seems that there is some hope for an electrical rain precipitator, properly employed, but from the wealth of scientific literature and opinions available on the subject to-day, it does not seem at all probable that such apparatus or arrangements will ever be perfected in so far as we now know; in other words, we apparently can never hope to actually cause rain to fall unless Dame Nature is suitably disposed to such an effect.

ELECTRIC GYROSCOPIC STABILIZERS.

(*Continued from page 6*)

gyroscope stabilizer is its ability to cause the ship to roll for the purpose of freeing it from, or rolling it off, sand and mud banks.

When used on a battleship the stabilizer will insure all the advantages mentioned before in connection with a passenger liner and also these benefits. It will decrease the amount of underwater armor necessary on men-of-war in order to protect that portion of the hull which might be exposed to the enemy by rolling. It will improve conditions for the crew and officers by reducing the fatigue and other effects incurred from the incessant motion and will make it possible to go into action in any sea or upon any course in rough waters. Moreover it will make the gun-firing more accurate. Thus it can be seen that a "stabilized" navy would be superior, even in moderate weather, to an "unstabilized" fleet. The sole object of a fleet is to strike the mark, and if the number of hits can be doubled, it means the virtual doubling of the navy. Although there are other advantages which might be mentioned in connection with this device, yet those which have been enumerated are sufficient to clearly bring out the value of this remarkable product of the human mind.

Not only has the gyroscope been utilized on ships for stabilization, but is also being used for recording the magnitude of rolling. Several have been built in the past, but the one depicted in Fig. 5 is the latest and most improved form of gyroscopic and pitch recorder. The gyro of this recorder, which is observed at the left of Fig. 5, is equivalent to a pendulum some six miles in length and weighing about six tons. This forms an absolute base line to which two recording pencils are attached and about which the ship recording chart rolls and pitches. A clock electrically marks off the time period, and the amplitude is measured by a graduated rule. Thus, the period and amplitude of both roll and pitch are recorded continuously in a graphic manner.

Aeroplanes that are being operated at present are not reasonably safe because of their unstable condition when the machine is caught in a gale, or when the operator becomes nervous and loses control of the machine. Most accidents which have occurred up to the present have been due to this cause, although there have been others. Various schemes have been developed from time to time to eliminate the disastrous effects engendered when flying an aeroplane, but none has proved very successful.

The wonderful properties of the gyroscope have been used advantageously in building a suitable stabilizer for aeroplanes. Such a device is illustrated in Fig. 6. The two gyros control various electrical circuits which operate suitable drums as depicted, which are connected to the different rudders, ailerons, etc., by means of steel wires. With this means of stabilizing, the aeroplane is rendered perfectly safe, in so far as it can be. The gyroscope stabilizer is the most perfect device ever brought before the aeronaut to keep his machine in perfect equilibrium while he is flying.

When fully developed, the gyroscope should be an important factor in making safer than ever before all ocean and aerial travel. Thus, once again, a product (once a toy) of the scientists' laboratory bids fair to become one of the greatest blessings ever bestowed upon mankind.

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MARVELS OF MODERN PHYSICS

(*Continued from page 23*)

plain developments of the future as it has those of the past.

Such theories give us, too, a working basis for further search after the answer to that question of the ages as to what really constitutes matter. It seems probable that the electron may be only an electric atom with no material body, but with reference to the positive particle we are completely in the dark. If we assume that there is such a thing as matter besides the unit of electricity, then we are up against another riddle as to what it may be. The simplest suggestion we can make is that the *atom is the volume of ether cut out by electrons rotating about a nucleus.* It is interesting to note what a scientist of 2,500 years ago thought. Nearly 500 years B.C. Anaximenes advanced the theory shown in Fig. 3 that all matter was composed of one fundamental substance which he believed to be air. The air, he said, if condensed, would form water and if still further condensed would form the denser materials such as those composing the earth. He added that a rarefication of air would produce fire, but unfortunately for himself he was never able to prove his contentions. Laughable as this theory now seems to us, yet it is worthy of note that even then there was the idea that some "one" element was

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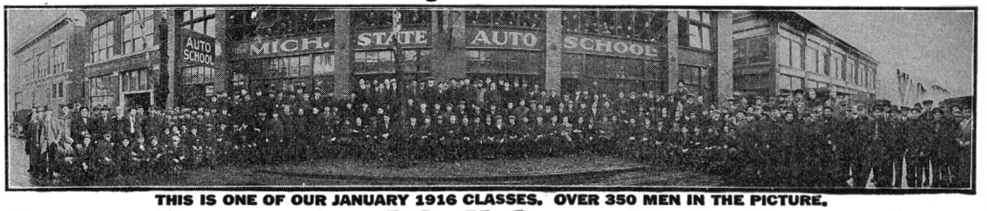

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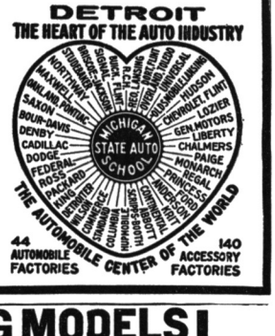

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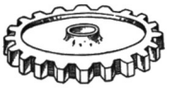

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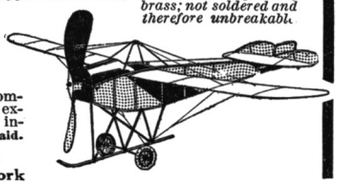

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the fundamental constituent of all matter. This same idea was advanced by Prout in 1815, who thought that all elements could be built up of hydrogen atoms in varying combinations. This seemed likely at that time as the atomic weights of the known elements were exact multiples of the atomic weight of hydrogen. Later elements were discovered, however, whose atomic weights disproved Prout's hypothesis. In 1869 an important relation between the elements and their atomic weights was shown by Mendelejeff and Meyer, which developed into what is now known as the *periodic system.* This system indicated that elements resembling each other may be arranged in eight groups, and at the same time in the order of their atomic weights. On doing this, Mendelejeff found that in a table of elements so arranged, there were a number of blank spaces. These he attributed to the fact that some elements were relatively rare, and had not been discovered, and he was led to predict their discovery, and even their atomic weights and properties. His predictions were fulfilled in a remarkle manner by several newly discovered elements, but there are still several blanks to be filled.

The periodic system led to the conclusion that the atomic weight seems to be the fundamental property of an element which determines the other properties. This was quite a natural conclusion which has received new meaning and new value since the recent developments in electricity. The close relationship existing between the elements is more evident than before, but the facts of radio-activity have given us our latest information. It has been found that radio-active elements go through a series of changes on account of atomic disintegration giving off electrons and positively charged particles which have been proved to be charged helium atoms. As these helium atoms are expelled the remaining atom becomes lighter, and falls back step by step, in the periodic system until the final product of the Uranium-Radium series is *lead.* Van der Brock in 1913 announced his theory that all elements are composed of hydrogen nuclei, helium nuclei and electrons, and similar theories are held by most scientists. The fact that the electron is only 1/100,000 the size of a hydrogen atom explains why the atomic weight of a substance does not change an appreciable amount when electrons are ejected. Thus the unoccupied space in an atom is far less than the occupied space. In fact, if the atom were magnified to the size of one of our planets, the distances of the electrons from their nuclei would be comparatively the same,

as the *distances of the planets from the sun.* We can imagine then that the atom is a solar system in miniature, and just as our solar system is aging with time, and growing cold, so may the atoms of the various elements be aging, and dying in some instances. This seems to be strikingly illustrated in the case of radium where we have these minute systems breaking up rapidly and continuously. It was Spencer who advanced the theory that the universe and everything whatsoever that exists is in a process of evolution, and though we may not agree altogether with Spencer, certainly the idea of evolution is pervading all sciences and fields of thought, and we can only say that nothing is impossible.

[This is the Fourth paper of a series prepared especially for The Electrical Experimenter by Mr. Rusk —EDITOR.]

THE WIRELESS WIZARD'S GHOSTLY CONSPIRACY

(*Continued from page 21*)

After much thought and the Wizard's assistance we succeeded in unraveling the whole thing and made a drawing similar to the illustration and filed a copy in the club library for—well, just for, that's all.

The apparatus consisted first of a box containing a coherer, battery and relay. This was connected to an aerial erected in the garret of the building. When the relay closed it released a forty-nine-cent clock work mechanism magnetically, as shown. This release consisted of a strip of iron that engaged a cam on the shaft of the rotary switch.

When released, the switch moved over contact points and we determined by experiment that it took five minutes for a complete revolution, thus each exhibition would last that length of time.

The first contact started the motor which rattled the chain and wound up a cord that lifted an iron bar six feet long. The chain was connected to a lever which was alternately raised and dropped by means of a pin set in a disk as shown. The other pulley was held in contact with the motor pulley by means of a spring and when the second contact was made it energized an electro-magnet which pulled them apart and allowed the rod to drop to the floor, thus imitating a pistol shot that sounded realistic under the condition of mystery surrounding the whole affair.

The next contact started the motor driving the phonograph which accounted for the shriek, moans and ensuing laugh.

The remaining three contacts controlled the projector. On the switch lever touching the first it lit the lantern which was supplied with acetylene gas from a generator and swung by means of a magnet to point at one window. The mechanism for lighting the gas is not shown, but it was similar to that used for lighting ordinary illuminating gas burners and had a spring return. Thus it hit every time the lantern was shifted.

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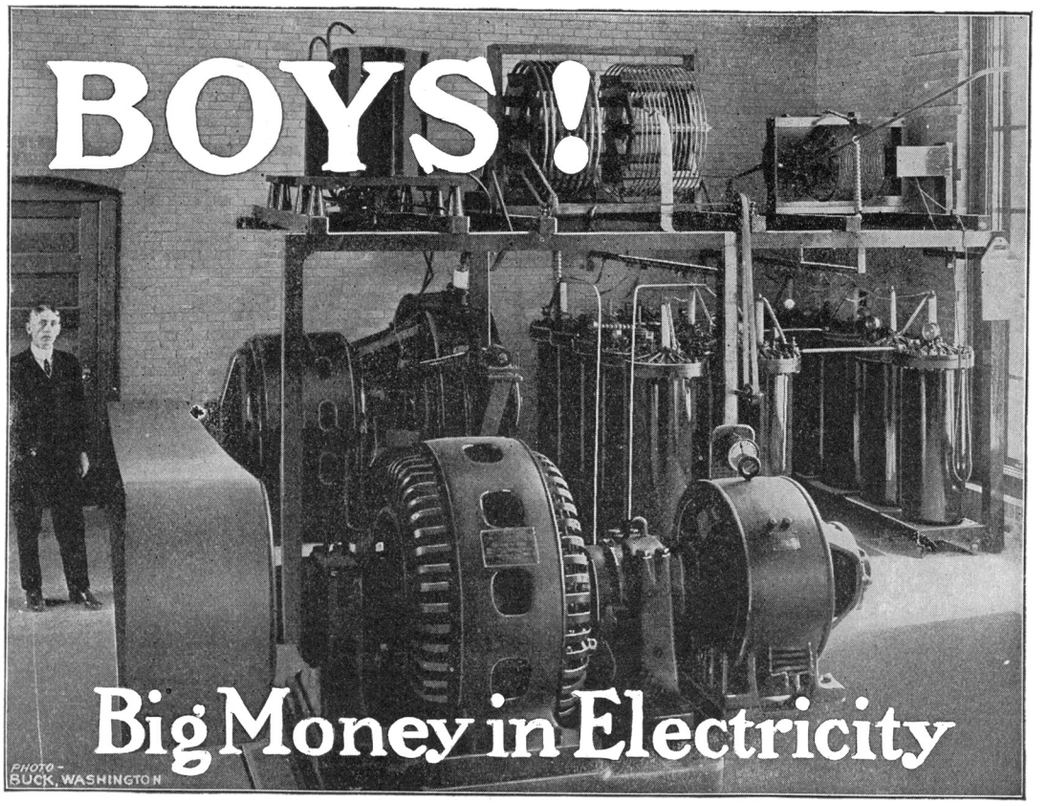
A long jointed pole called a "fishpole," forked at the upper end so as to secure a good circuit, is used to connect the instrument with the overhead wires. When not in use the pole folds into a small box.



Spark Transmitter, Arlington (N A A) Radio Station

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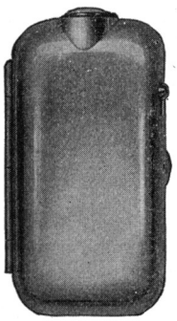

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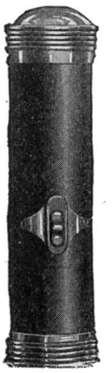

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The arrangement for swinging the lantern was very simple. A shallow box formed the base and the projector was pivoted on a shaft that extended inside the box. On the end of the shaft was mounted an iron rod at right angles to act as the armature for the three electro-magnets. The latter were placed in such a position as to attract the rod and by so doing point the lantern at the proper window, the dust on the window forming a sort of semi-opaque screen that softened the outlines and gave a very ghostly effect.

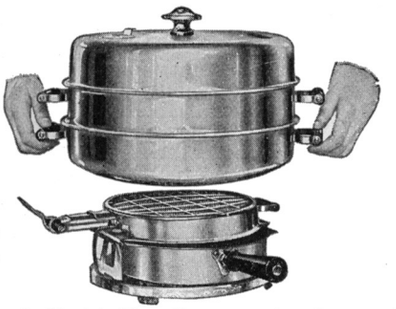
Apparently it was a leaky hose supplying gas to the projector that queered the "Wiz's" game by starting the fire. "I'll stick to 'juice' hereafter," quoth he with a grimace as someone put forward the above theory.

The "Wiz" confessed, under pressure, that an alarm clock was used to give the curtain cue. He employed a spool mounted on the alarm spindle to wind a cord and pull a switch blade over the contact operating the distant sending set long enough to act on the coherer connected to the apparatus in the house.

The evening as a whole had been filled with surprises and every emotion had been played on as if by a master hand. The "Wiz" had caused fear, anger, humor and what not in turn and humanlike we endeavored to get back at him with a session of unalloyed kidding. He took it all in good part, but as he bade us goodnight dropped a remark that will keep us thinking awhile; namely, "He who laughs last is not always an Englishman, sometimes he may be a Yankee!"

NOW WE HAVE THE "OVENETTE."

The many advantages of the electric oven are obvious, but heretofore the original cost



Handy Electric Stove Known as the "Ovenette."

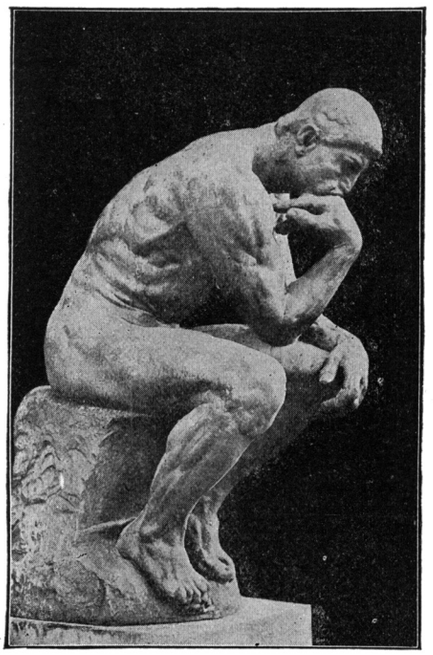
of purchasing and installing it has kept many families from trying this clean, cool method of cooking.

Such obstacles need no longer deter the home-keeper, since there has now been produced a small oven for use on the Hotpoint electric stoves of the highly efficient, glowing-coil-reflector type. It is shown here over one of these small stoves. Now every household may have a miniature electric range at small cost and one that operates from any ordinary lamp-socket.

The "Ovenette," as the new device is named, is made of pressed steel, finished in highly polished nickel. As shown by the illustrations, it is made in three sections, adaptable to two distinct sizes, for economy in cooking.

The price of the "Ovenette" is low; and, combined with the well-known superiority of electric cooking, will undoubtedly result in familiarizing thousands of families with this 20th-century method.

The island of Borneo boasts a telegraph line constructed of mahogany and ebony poles. This is no doubt the most valuable telegraph line in existence.



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Try communing fifteen minutes a day with the greatest thinkers the world has ever produced, and you will be surprised at the effect on your mental growth. The mind, like the body, gains strength through nourishment and exercise. The best mental nourishment that could be prescribed is found in the volumes whose titles are given below, and the best exercise, thinking over the revelations they contain.

Again—some foods are nourishing but not palatable to all tastes. But the mental food we are recommending *is palatable* because the books are interesting and entertaining—in fact, they are wonderful.

Our modern civilization, the product largely of the tremendous advances in knowledge of the last half century—the age of Darwin and his fellow scientists—is the concrete expression of the thought contained in—

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Prof. Lombroso's Book on Criminology

As an illustration of the wide scope of this set, there is the volume on The Female Offender, by Prof. Lombroso. No more startling revelations can be found anywhere than those contained in the picture he draws of one aspect of the underworld in this book. The Social Evil is as old as creation. We find references to it in the records of the earliest civilizations. The descendants of Jezebel and Messalina are to be found in every stratum of society. The lair of "The Scarlet Woman" is located in almost every community. No study of Sociology therefore is complete that does not take into account her malign influence, and the correct measures necessary to combat that influence. Prof. Lombroso's work made an epoch in criminology because of the wide scope and systematic character of his researches.

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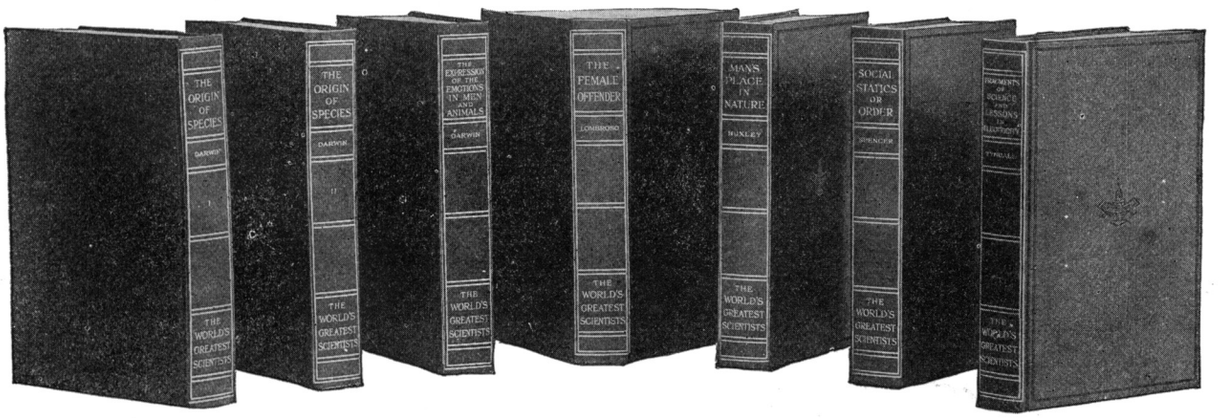

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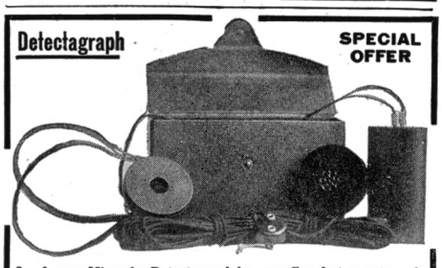

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1. *Absorption, Atmospheric:* That portion of the total loss of radiated energy due to atmospheric conductivity.
2. *Ammeter Hot Band; Hot Wire*: An ammeter dependent for its indications upon the change in dimensions of an element which is heated by a current passed through it.
3. *Ammeter, Thermo*: An instrument for measuring current, depending for its indications on the voltage generated at the terminals of a thermo-junction, heated either directly or indirectly, by the current to be measured.
4. *Amplifier or Amplifying Relay*: An instrument which modifies the effect of a local source of energy in accordance with the variations of received energy; and, in general, producing a larger indication than could be had from the incoming energy alone.
5. *Amplification, Co-efficient of*: The ratio of the useful effect obtained by the employment of the amplifier to the useful effect obtained without that instrument.
6. *Antenna*: A system of conductors designed for radiating or absorbing the energy of electromagnetic waves.
7. *Antenna, Directive*: An antenna having the property of radiating a maximum of energy in one (or more) directions.
8. *Antenna, Flat Top*: An antenna having horizontal wires at the top covering a large area.
9. *Antenna, Harp*: An antenna having an approximately vertical section of large area and considerable width.
10. *Antenna, Inverted L*: A flat top antenna in which the leading down wires are taken from one end of the long, narrow horizontal section.
11. *Antenna, Loop*: An antenna in which the wires form a closed circuit, part of which may be the ground.
12. *Antenna, Plain*: An approximately vertical single wire.
13. *Antenna, T*: A flat top antenna in which the horizontal section is long and narrow; the leading down wires being taken from the center.
14. *Antenna, Umbrella:* One whose conductors form the elements of a cone from the elevated apex of which the leading-down wires are brought.
15. *Antenna Resistance*: An effective resistance which is numerically equal to the ratio of the power in the entire antenna circuit to the square of the R. M. S. (Root Mean Square) current at a potential node (generally the ground).

    NOTE.—Antenna Resistance includes:
    Radiation resistance;
    Ground resistance;
    Radio frequency ohmic resistance of antenna and loading coil and shortening condensers.
    Equivalent resistance due to corona, eddy currents and insulator leakage.
16. *Arc*: The passage of an electric current of relatively high density through a gas or vapor; the conductivity of which is mainly due to the electron emission from the self-heated cathode. Under present practical conditions, the phenomena take place near atmospheric pressure.
17. *Arc Oscillator*: An arc used with an oscillating circuit for the conversion of direct to alternating or pulsating current. The oscillations generated are classified as follows:

    Class (1)—Those in which the amplitude of the oscillation circuit current produced is less than the direct current through the arc.

    Class (2)—Those in which the amplitude of the oscillation circuit current is at least equal to the direct current, but in which the direction of the current through the arc is never reversed.

    Class (3)—Those in which the amplitude of the initial portion of the oscillation circuit current is greater than the direct current passing through the arc, and in which the direction of the current through the arc is periodically reversed.
18. *Attenuation (Radio)*: This is the decrease, with distance from the radiating source, of the amplitude of the electric and magnetic forces accompanying (and constituting) an electromagnetic wave.
19. *Attenuation, Co-efficient of (Radio)*: The co-efficient, which, when multiplied by the distance of transmission through a uniform medium, gives the natural logarithm of the ratio of the amplitude of the electric forces at that distance to the initial value of the corresponding quantities.
20. *Audibility*: The ratio of the telephone current variation producing the received signal, to that producing an audible signal. (An au-

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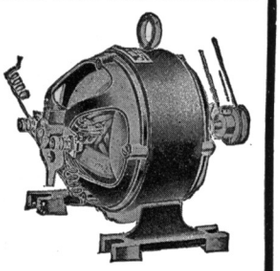

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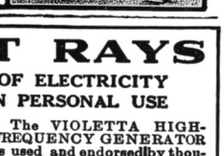

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dible signal is one which permits the mere differentiation of dots and dashes.)

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MODERN CONCEPTS OF ELECTRICITY.

(*Continued from page 20*)

with a sensitive electrometer. The cylinders are therefore placed so as to be out of the direct line of direction of the rays. Now, when the discharge passes through the tube and the cathode rays passed horizontally through the vessel C, the inner cylinder E will receive a small negative charge. The cathode rays were then deflected by a magnet; their path could now be inferred from the position of the phosphorescent patch on the walls of C. When the inflection was increased, so that the position of the path showed that the rays had fallen on the opening of the cylinder, there was a very great increase of negative charge received by E, as shown by the electrometer F; when the rays had been so much deflected that the phosphorescent patch fell below the slit the negative charge in the cylinder E again disappeared.

This experiment shows again that the rays carry a negative charge, as it proves that the negative electrification follows exactly the same course as the rays producing the phosphorescence on the glass.

Fig. 5 illustrates the cathode ray deviated by a permanent magnet. The rays emanating from radio-active substances are classified as the alpha, beta and gamma rays. The alpha ray is composed of positive corpuscles, the beta rays composed of negative electrons, while the gamma rays are ethereal pulses which are not affected by magnetism. The X-rays belong to the same class as the gamma rays, as they are not deviated by magnetic forces, and these rays are produced by the sudden increase in speed of the cathode ray. Since the electron carries an electric charge, it possesses an electrostatic field, and in consequence the ether around every electron is in constant strain. In an X-ray tube the cathode ray is focused upon a platinum target, from which the X-rays are radiated; now the sudden collision of the electrons with the target produces a short pulse of energy in the electrostatic field in the ether. This pulse is the X-ray. The steady succession of these impacts of rapidly moving electrons gives rise to these rays, which are ethereal pulses of short wave length and high penetrative power.

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THE WASHINGTON'S BIRTHDAY AMATEUR RADIO RELAY.

(Continued from page 25)

THE HONOR LIST

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Alabama Polytechnic Inst.....Auburn
Harold S. Brownell.....Birmingham

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J. M. Clayton.....Little Rock

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Serg. Clodfelter—N.G. of N.C.—Winston, Salem

SOUTH CAROLINA
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H. P. Maxim.....Hartford

GEORGIA
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Robt. Karlowa.....Rock Island
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W. H. Allison.....Worcester
W. B. Burgess.....Worcester

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E. E. House.....Battle Creek
Geo. McBride.....Bay City

MINNESOTA
Eben R. Dennis.....Hutchinson
Minneapolis Wireless Club.....Minneapolis

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Prof. A. S. Blatterman.....St. Louis
W. H. Carroll.....St. Louis
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L. Spangenberg.....Lake View
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WISCONSIN
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REVISED LIST OF AMATEUR RADIO CLUBS.

(Addition to list published in April issue.)

Amateur Radio Association of Buffalo. Secretary, Newton Frank, 411 Humboldt Avenue, Buffalo, N.Y.

Amateur Radio League, Elko, Nev. Secretary, Gerald Fitzgerald, 432 Fourth Street, Elko, Nev.

City College Radio Club, City College, N.Y. Secretary, Herbert Kayser, 41 Convent Avenue, New York.

Connecticut Valley Radio Club, Technical High School, Springfield, Mass. Secretary, George Beecher, 416 Allen Street, Springfield, Mass.

Norristown Radio Club, Norristown, Pa. Secretary, Donald K. Walker, 552 Kohn Street, Norristown, Pa.

Portland Radio Association, Portland, Me. Secretary, C. T. Beardsley, 487 Congress Street, Portland, Me.

Prospect Radio Club, Brooklyn, N.Y. Secretary, L. Jacquet, 478A Sixteenth Street, Brooklyn, N.Y.

Radio Association of Maryland, Arlington, Md. Secretary, T. N. Cox, Bancroft Park, Arlington, Md.

Radio Club of DeWitt Clinton High School, New York City. Secretary, Emanuel J. Weil, 134 W. Eighty-sixth Street, New York City.

Radio Experimental Club of New Orleans, New Orleans, La. Secretary, C. Ashley Coe, 311 Baronne Street, New Orleans, La.

Rochester Scientific Institute, Rochester, Minn. Secretary, Donald Tollefson, care of The Rochester High School, Rochester, Minn.

Rockaway Radio Club, Rockaway Beach, L.I. Secretary, Vernon Hanson, 15 Beach One Hundred and Fourth Street, Rockaway Beach, L.I.

San Francisco Radio Club, San Francisco, Cal. Secretary, Thomas J. Ryan, 82 Downey Street, San Francisco, Cal.

Washington Wireless Association of Trenton, Trenton, N.J. Secretary, Walter E. Harvey, Washington Market, Trenton, N.J.

Y.M.C.A. Radio Club, 153 East Eighty-sixth Street, New York City. Secretary, J. Di Blasi, 153 East Eighty-sixth Street, New York City.

Notice: To ensure proper entry of club registrations in our revised monthly list be sure to send us at once the data outlined below. Such information should reach us not later than the 28th of the month for entry in the succeeding issue of THE ELECTRICAL EXPERIMENTER.

Name of Club.....
Location (street and city).....
Founded .....
No. of Members.....
Meeting Date.....
Power of Club Set, if any.....
Call Letter (licensed?) .....
Dues and Initiation Fee.....
Secretary's Name and Address.....

CORRECTION NOTICE.

We are requested by Donald R. Graybill of Polo, Illinois, to publish a correction of his address, as his wireless station in the Licensed Amateur List on page 428 of the December, 1915, issue of *The Electrical Experimenter* was given as Polo, Indiana, instead of Polo, Illinois.

The Use and Construction of a Wireless Telephone Set.

(*Continued from page 32*)

through the box and fastened to the handle. In this way the switch is out of sight but easily put on or off.

Mounting.

When the instruments are all made, they are ready for mounting in the case. Fig. 2 shows the position of the coils and condenser. All wiring must be of high tension cable and insulated by porcelain tubes where it passes through the case. One terminal is provided for the insulated transmitter electrode; the other wire must be soldered to the brass shell. To make the set more stable it is well to screw small pieces of brass strip to the sides of the case and at the bottom so that the outfit may be fastened to the table on which it rests. An adjustable rheostat should be inserted in the circuit at R (Fig. 1). The rheostat should have 14 to 15 ohms resistance and may be made of No. 16 iron wire or 18% German silver wire.

Operation.

When the current is switched on, and the motor adjusted to a speed which will rapidly rotate the copper disc, push the carbon rod quickly against the wheel to strike the arc. This may require several attempts. Once the arc is started, adjust it to a steady flame. To regulate the current supply, move the iron core of the choke coil in or out and regulate the rheostat R.

It is absolutely necessary to tune the closed antenna circuits to resonance. The easiest method is to use a wave meter. The circuits are adjusted in the same way that the circuits of an ordinary spark sending set are adjusted. If no wave meter is available, any variable condenser and coil, connected as in Fig. 3, can be used. The procedure is as follows: 1. Disconnect the closed circuit clips 1 and 2, Fig. 1, from the helix. 2. With a spark coil in the ground lead, set the clip 3 on about the fourth turn, so that the emitted wave will not be over 200 meters. 3. Adjust the condenser until the sound in the receivers is the loudest when the spark coil in the ground lead is operating. *Note the scale reading.* 4. Disconnect the aerial and clip 3 from the helix. While the arc is in operation, adjust the sending condenser and clips 1 and 2, until the sound is the loudest in the receivers and at the same point on the wave meter scale which was noted in 3. 5. It will probably be necessary to further adjust the clips to give the proper coupling between the circuits. If possible, use a hot wire ammeter in series with the two circuits when making adjustments. An oscillation transformer, having two spirals, one stationary and the other hinged, gives more accurate tuning, but it is not essential. Great care must be taken in making the adjustments in the circuits as the range of the wireless telephone depends largely upon them.

Connect a small geissler tube across the helix clips to indicate when oscillations are being produced. A hot wire ammeter in the ground lead can be used to show the radiation.

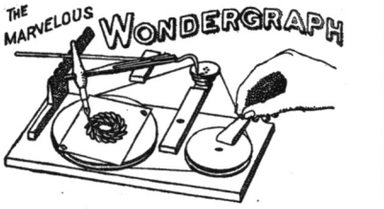
After making the necessary adjustments speak plainly and in a low tone into the transmitter. You will in this way be able to talk to your fellow "radio-bugs" over a comparatively long distance, considering the power that you will be using. A phonograph or musical instrument played in front of the transmitter will furnish wireless music to your friends. There are many interesting experiments and research tests that can be carried on with a set like this.

We hope that any one who builds this set will write to us, describing the results they obtain, together with photographs of the instrument as constructed.

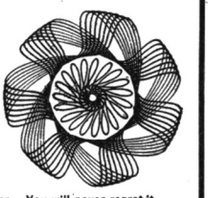
BOYS--GIRLS

LOOK! Something New

THE MARVELOUS WONDERGRAPH



'MARVELOUS' is the only word that properly describes the **WONDERGRAPH**. This machine will turn out Pen and Ink designs (also in colors) by the thousands. Everyone different. Not a plaything, really a machine that is an education in designing. Will hold the Boys' or Girls' interest (also grown-ups) by the hour. (See cut for sample design.)



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Write at once for this Special Offer. You will never regret it.

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READ the Classified Advertisements in this issue. They are small but contain big barga.ns and opportunities.

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Tub Guaranteed For 10 Years

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☐ Gas Engineer	☐ Stenographer and Typist	
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☐ MINE FOREMAN OR ENGINEER	☐ Commercial Law	
☐ Metallurgist or Prospector	☐ GOOD ENGLISH	
☐ STATIONARY ENGINEER	☐ Teacher	
☐ Marine Engineer	☐ Common School Subjects	
☐ ARCHITECT	☐ CIVIL SERVICE	
☐ Contractor and Builder	☐ Railway Mail Clerk	
☐ Architectural Draftsman	☐ AGRICULTURE	
☐ Concrete Builder	☐ Textile Overseer or Supt.	
☐ Structural Engineer	☐ Navigator	☐ Spanish
☐ PLUMBING AND HEATING	☐ Poultry Raising	☐ German
☐ Sheet Metal Worker	☐ AUTOMOBILES	☐ French
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Ohio Auto School
Dept. 201, 1521 Prospect Ave.
CLEVELAND, O.

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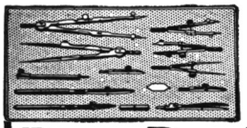

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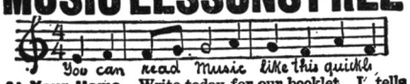
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ONE OF THE MOST REMARKABLE ELECTRIC APPARATUS EVER BUILT BY MAN.

(*Continued from page 12*)

diameter and 28 inches outside diameter. This winding was made of 122 coils, each coil consisting of 44 turns of copper ribbon separated by two thicknesses of 6 mil paper. The copper ribbon was 20 mils by 281 mils, being equivalent to No. 12 copper wire. The coils were spaced one-quarter inch apart, with every two connected in series, forming a number of 2,200 volt groups, and the winding consisted of 61 groups in parallel. The connections between the two coils were fastened to a heavy copper busbar running the entire length of the primary winding and thoroughly grounded to the frame and the earth. The grounding of the neutral acted as an electrostatic ground shield, to prevent any static disturbances on the 2,200 volt winding from the million volt secondary coil.

The main insulation barrier between the low voltage coil and the high voltage coil through which the induction took place was an insulating tube made up of paper impregnated in a hot insulating solution under a vacuum. This tube was 92 inches long with an internal diameter of 29½ inches and an external diameter of 41½ inches, thus giving a wall thickness of 6 inches.

The high voltage coil consisted of 190 coils, rated at 5,300 volts each, connected in series. Each coil was wound with 212 turns of *aluminum foil* 8 mils by 135 mils, with three thicknesses of 6 mil paper between turns, thus forming a tube 71 inches long, 43 inches inside diameter and 51 inches outside diameter.

The device weighed approximately 30,000 pounds and consisted of 26,000 pieces of aluminum, copper, steel, iron, fibre and paper. More than 400 miles of paper, aluminum and copper were used in the construction of all coils, 90 miles of aluminum and 270 miles of paper being used in winding the secondary coil alone.

The above construction was the most radical difference in design from the standard manufacture of to-day, in the elimination of all taping of coils, there being no cotton, silk or paper wound wires, thereby exposing the bare surface of all turns to free oil and depending altogether upon oil insulation between coils. In making some of the tests with the completed transformer *2,000,000 volts* on surges took place; and when discharges occurred between coils there was no short-circuiting of the windings; and what slight breakdown of material resulted was always easily and quickly repaired, the open-winding construction admitting of easy access and never rendering it necessary to take the transformer apart.

Several prominent engineers and scientists and the writer witnessed several phenomenal spark discharges in the form of short-circuits beneath the oil in the large transformer tank, when terrific surges were caused in the system. These were awe-inspiring, the sounds therefrom resembling confined thunder, if that idea conveys an impression. At one time the surges were allowed to become so great that the potential stress became unbelievable. Evidence of this is shown by the fact that one spark bolted downward from the million volt terminal *through 1 inch of fine insulating paper, 1½ inches of heavy plate glass and 24 inches of oil.* The imagination is here freely left to estimate the number of volts behind that particular spark. A conservative estimate by the engineers in attendance was 6,000,000 volts.

Before passing to a highly interesting phase of the experiments and demonstrations conducted at the Exposition, the method of insulating the tremendous voltage handled will here be described:

Mr. Thordarson also employed an innovation in this matter and one not without practical aspects. Its success was highly gratifying and without it the experiments would never have been performed. The inventor suspended the entire high potential main conductor and charge-carrying system by half-inch hemp rope in lengths of about 15 feet, which had first been soaked in melted paraffine and then in molten tar. Now if these prepared ropes only had been used at suspension points, much more than 15 feet per length would have been required. Therefore he designed and placed at each suspension point a corona-discharge basket constructed out of iron wire. One of the accompanying illustrations shows one of these shields which spread out over the insulating rope a distance of 16 inches, clearing the rope fully 8 inches and thus distributing the electrostatic stress away from it, thereby avoiding burning it off at the junction point or elsewhere. The large overhead wire screen was strung from four ordinary electric light poles, and the success of the insulating scheme was demonstrated particularly well by the fact that during rain storms no noticeable leakage or burning of ropes occurred, while the sustaining ropes of the under or rope safety net which were not "prepared," burned off merely from the *induced charge* it carried.

When the phenomenal outdoor screen system was charged to 100,000 volts or more it became luminous, its sizzling of corona discharges being audible several hundred feet away. Higher voltages produced visible corona against a starlit sky measuring 6 inches and more. Around the main, overhead conductor leading out of the transformer, a corona 18 inches across was at one time noticed. Strangers approaching the charged screen were often greatly surprised in discovering the far outreaching power of the charge if carried. A good illustration is that of a party driving up in an automobile to within fifty feet of the screen and stepping out onto the ground. When the last part of the body to loose contact with some metal part of the machine, standing insulated as it was on its rubber tires, broke that contact, a very perceptible shock indeed passed through the person. In fact, a small spark could be continuously drawn from the metal parts of the machine. Another means of judging the enormous stress in the charged screen was the ability of anyone to draw from the rope safety screen, with a grounded conductor (when the upper screen was energized by 400 H.P. at a potential of 500,000 volts) sparks 2 feet in length accompanied by miniature thunderclaps.

Every night beneath the screens the spectacle was witnessed of dozens of persons moving about in the charged space enjoying the peculiar sensations produced. The most noticeable of these was that of a sim-

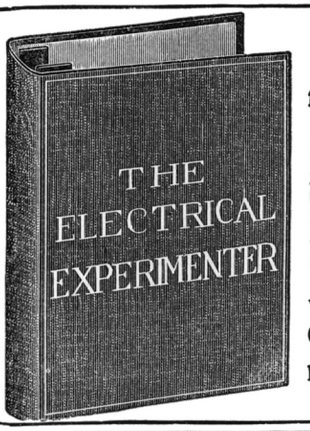
GENERAL ELECTRIC CO. WINS TUNGSTEN PATENT SUIT.

A decision handed down by United States District Judge Julius M. Mayer in New York City, recently, makes the General Electric Company sole owners of American patent rights on Tungsten lamps. The action was brought by the General Electric Company against the Laco Phillips Company, importers, for alleged infringement on patents on Tungsten lamp bodies, which were purchased from Just and Hanaman, the inventors, about 10 years ago at a cost of $400,000.

The contention of the defendants was that Hanaman and Company were not the inventors, thus making the patent invalid.

ilarity to walking under water, like a diver would, hampered in every way. Mr. Thordarson was heard to remark upon this wonderful condition that if the potential of the top screen were raised to the steady potential of 1,000,000 volts or higher, no human being could withstand the stress beneath. At 400,000 volts persons there stood a few inches off the ground on wooden insulating boxes and easily imparted 3 to 6 inch sparks with endurable shocks to other individuals on the ground; the hair on the head was raised and stiffened the nearer it was brought to the overhead screens and the scalp continually experienced a prickling sensation in a million points; when the face was held upward a very pronounced formation of ozone occurring at the very nostrils was detected. If the hat was raised off the head while standing there a discharge of sparks took place from the band. If it were held in the air a half-inch spark could be drawn from the band with the thumb of the same hand. Holding it close to, but not touching the head, one could hear the familiar hum of the alternating generator. All manner of antics went on within incandescent lamp bulbs, vacuum tubes and helium and neon gas tubes brought under the screen. Some ordinary unused lamp globes when held by their brass bases had their filaments violently shaken, some bending far out of place and adhering to the glass sides, others shattering into fragments immediately. Leyden jar charges were easily and often unexpectedly discharged by many of the lamps. Several neon and helium gas tubes in elongated form were used, and when held above the shoulders and slowly waved back and forth exhibited visible proof of the alternate passage of positive and negative flows of current; the steady glow of the tubes when held stationary being broken up into oscillating flashes of two different shades of color. And this interesting thing also occurred: Any tube held above the shoulders glowed properly, but if held near the body, and lowered, its luminosity gradually disappeared the further down it was held. A large, powerful tube was thus lowered within a three-pointed circle formed by three persons; the de-energizing point seemed to be opposite the shoulders when the three persons were within two feet of each other, and at about the waistline when they were three feet apart. Still another very interesting phenomenon was shown: Any tube would glow properly held in any position in this electrostatic field. And hair-pins and safety-pins tickled in a surprising manner wherever the owner walked about under the magic wires.

Another very interesting place was that corner within the building where the operator and the controlling devices were caged in on all sides by heavy iron grating. "Safety First" was ever the watchword in that corner where man-made lightnings darted here and there in their fury.



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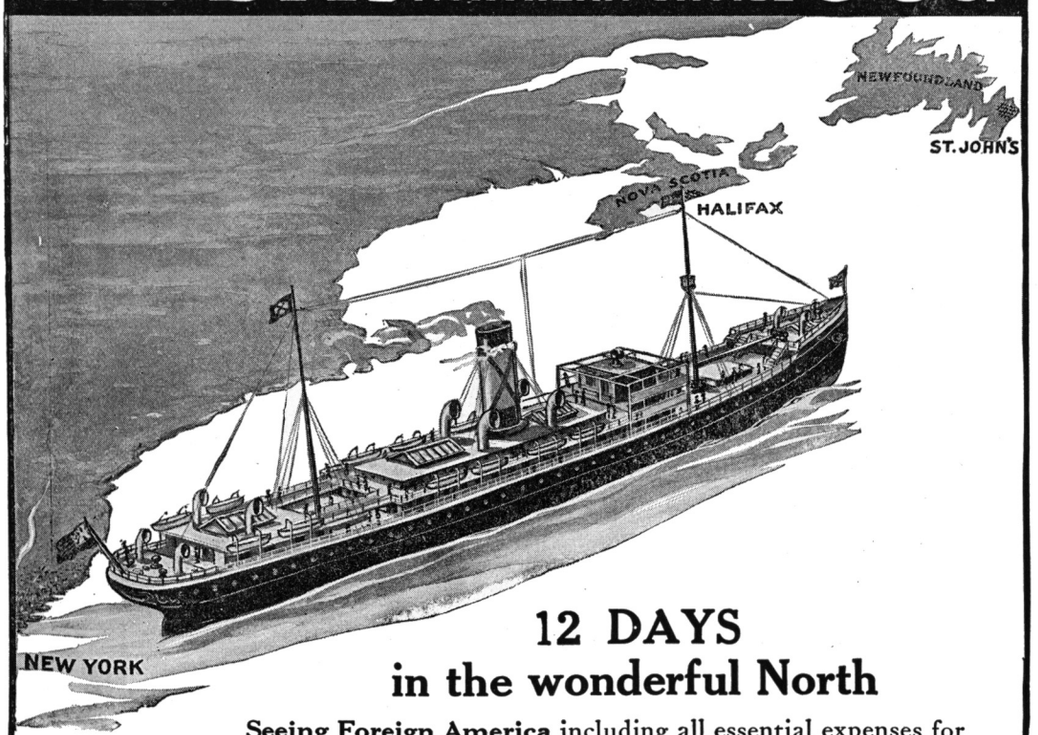

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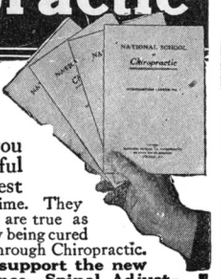

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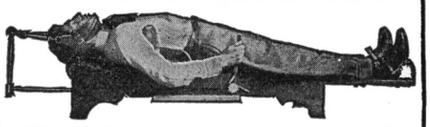

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BOOK REVIEW

MECHANICAL ENGINEER'S POCKET-BOOK. By William Kent, M.E., Sc.D., and Robert Thurston Kent, M.E. 1,526 pages; profusely illustrated; 4½x7 inches. Leather bound, gilt edges, ninth edition, 1916. Published by John Wiley & Sons, New York City, N.Y. Price $5.00.

This is latest edition of the leading hand-book for mechanical engineers and those interested in the many diversified branches of the art. It will be found of special worth to students, machinists, electricians, civil and electrical engineers, and all others who desire to have available for ready reference the boiled-down facts and working laws of steam, hydraulic and electrical machinery and allied devices. The forepart of the book deals with mathematics and includes elaborate tables of circle areas and perimeters, logarithms, sphere, segment and polygonal data, geometrical problems and their solution, etc., etc. The section on materials and their properties is very thorough and will be found of extreme value to machine designers and builders. Ropes, cables, chains, iron and steel beams and girders, stresses in framed structures, etc., are treated upon at length; also fans, flowers, heating and ventilation, flow of water through weirs, pipes and nozzles, water power, water wheels and their design (both large and small), power of ocean waves, tidal power, pumps of all kinds, fuels, chimney design, data of steam engines including locomotives, internal combustion engines, wire rope transmission, rope driving, machine shop data, including gear changes on millers and lathes, tool shapes and steel to be used, as well as cutting speed, besides improved methods of drilling, milling, grinding, etc. Ice making machinery, marine engineering and electrical engineering.

It is impossible in a limited space to do justice to everything that this ably edited work contains. The author is well known in professional circles and has performed much original work in the line of applied science, especially with regard to machine design and the important factors governing it. The various sections of the volume have been brought well up to date. In spots there seems to be an undesirable superfluity of technical magazine excerpts, notably in the chapter on locomotives. Some very desirable data is lacking in this section but this may be due to a dearth of available authentic data on the subject.

THE SECRET OF THE UNIVERSE—GRAVITY, ITS ORIGIN AND NATURE. By Eugene Miller. Cloth bound; 8x5¾ inches; 225 pages. Price, $1.60. Published by Crane & Co., Topeka, Kansas.

In this book Mr. Miller has brought out some truly radical theories.

The greater part of the book is a careful development of ideas which finally form the basis of his proof that the corpuscle, which he takes as the ultimate division of matter, has no weight when isolated from the atom which it composes. This is proven by simple mathematical formulas. In a further consideration of Newton's law of gravity he states that the increase in weight of a body is due to a crowding of the corpuscles. While there are no measuring instruments which can show this, there are some natural phenomena which do. Certain comets which approach the sun from great distances have been remarked to change greatly in size, growing smaller as they near the sun, and becoming larger again as they pass away. This seems to show on a large scale, that the corpuscles which compose the comets are crowding toward the center of gravity of the sun.

Another important and radical theory given by Mr. Miller is that the corpuscle is not matter, but "mind." The corpuscle does not have the characteristics of matter, since it has no weight. Moreover, it obeys a law, and this is characteristic of mind. Not that he claims that a corpuscle is equal to a man's brain, but it has the essentials which, if developed, would form the intelligence of a human brain. Here at last is something new. But will Mr. Miller's theory stand the acid test?

The benefit to experimenters in perusing this volume lies in development in reasoning power which results from following the thoughts and deductions of such a profound thinker as Mr. Miller.

AGES OF ICE AND CREATION, by George Prentiss. Cloth binding; 342 pages, 54 illustrations; 8x5½ inches. Price, $2.50. Published by The Common Good Co., Chicago.

Everyone who has believed in the accepted theories of creation and evolution will be surprised at the new ideas found in this book. They are not the products of a rabid mind; every statement is based upon natural laws and reason. Mr. Prentiss explains in a new way the rings which surround Saturn. He shows new reasons for the uniform climate, the Glacial Ages, and the Deluge. By a radical comparison with the present conditions of birth, he proves that natural conditions caused the creation of the first man, and later, the first woman. He explains the birth of children before the appearance of women, and the purpose of the vermiform appendix. With a further application of nature's laws, he overthrows the theories of Darwin and other scientists. The for-

(*Continued on page 70*)

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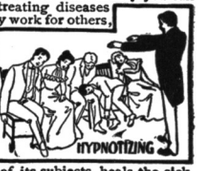

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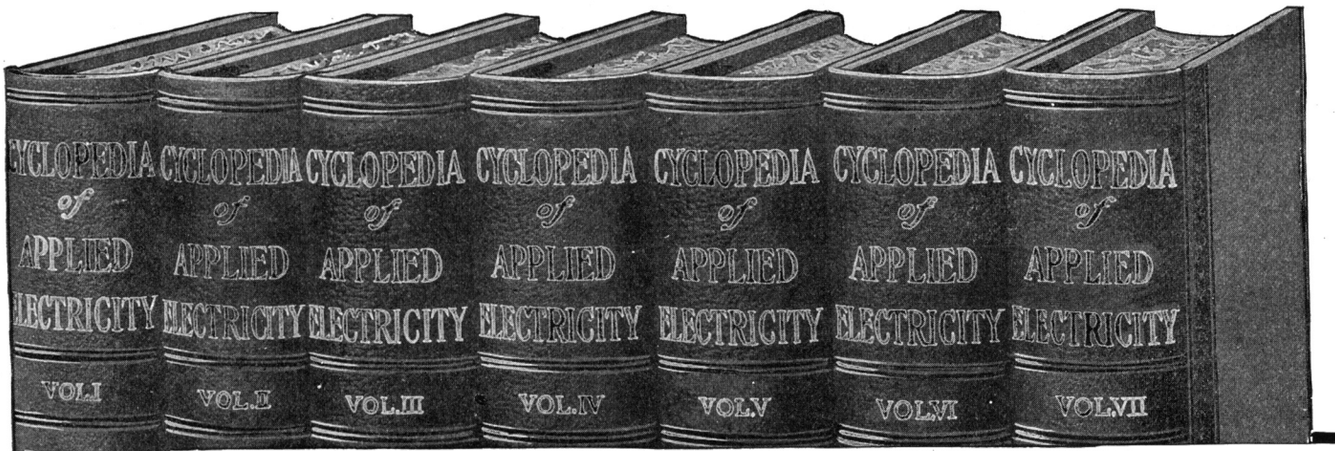

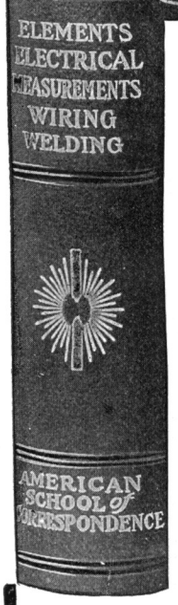

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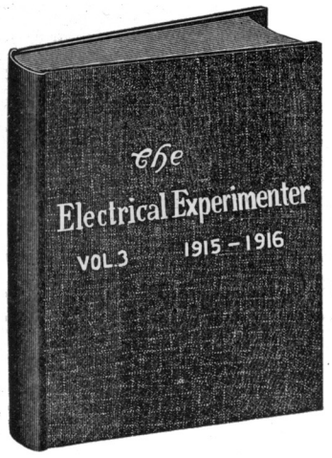

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BOOK REVIEW

(*Continued from page 68*)

mation of stratified rock and coalbeds is also described in a new way. Throughout the book he constantly makes a comparison with the Bible, to show how accurately it follows the natural process of creation. The language is extremely simple; it is not necessary to be familiar with the subject to understand Mr. Prentiss. Even those whose beliefs are already well grounded will find food for thought in this work.

With the Ad-Man

One of our readers, who signs himself M. W. B., Iowa, writes to ask my opinion as to "the value of correspondence school teaching." It's a good question and one I consider important enough to answer here, rather than by mail, for many, yes, too many, are skeptical as to the real benefit to be derived from correspondence school teaching.

A little consideration will cause Mr. Skeptic to see, however, that a good correspondence school or correspondence teacher does not only perform the vital function of teaching in a mediocre way, but it places at the service of the student in the most out of the way place in the world the teaching ability of frequently the best teachers in the one subject the student is studying.

I know of a few cases where young men who never finished their public school education, but had ambition enough to study an hour or two every day, to-day have positions that are far above those of many college trained men. And above all, there is a little secret that one of these correspondence trained men has told me about this class of studying that I'm going to divulge. I will quote him as well as my memory serves, "Yes, what I got out of their books and lesson papers was worth many times what I paid for them, but the training it gave me to devote an hour a day to study *has remained as a habit*, so that now 10 years after I finished my correspondence course I am still studious, for now it's a habit, not a necessity."

That man is going up steadily in his chosen work; the actual course started him on his upward climb fired by ambition and the desire to make good, but *he got more than he paid for* by training his body and mind to keep on learning without somebody having to show him.

If you really want to rise in the world and have the backbone and power of self-denial to put in real time to study, you make no mistake by taking a correspondence course.

And, lastly, a student of a resident school can be prodded on by his teacher, while a correspondence pupil must study by his own initiative, gaining thereby self-reliance, independence and the power to think for himself, an asset that is especially appreciated when an emergency arises.

MILTON HYMES.

BOOK REVIEW CORRECTION NOTICE.

Due to an error on page 732 of the April issue of *The Electrical Experimenter*, the book entitled "Elementary Principles of Wireless Telegraphy" by R. J. Bangay, listed at 50c. net instead of 35c.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 40,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Two cents per word* (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 30c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the June issue should reach us not later than May 1st.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

THE first check for $12 will buy $25 worth of wireless and electrical instruments, all factory made and new. Send for my list. Russell C. Taylor, 1337 Neil Ave., Columbus, O.

WANTED—Mignon RCI, Crystaloi, Turney buzzer, omnigraph, Grebe detector, superior 'phones, ⅛ H. P. motor, 110 volts, 60 cycles. All articles must be in good condition. Write. Jos. O'Connor, Shakopee, Minn.

FOR SALE OR EXCHANGE—Tuning coil, Universal detector, 6v. 80 ampere storage battery, rotary gap and rheostat; kick-back preventer, Murdock loading coil; want audion, phones, variable condensers, oscillation transformer. H. Semmelmeyer, 2629 N. Fairfield Ave., Chicago, Ill.

FOR EXCHANGE—A new 160-page copy of the 20 lesson wireless course and 12 month subscription of Electrical Experimenter to start when you want it for a dollar bill, old or new, Canada and foreign $1.50. Experimenter Pub. Co., Inc., 233 Fulton St., New York City.

HAVE two coupled sets, two box couplers, phonograph, fan, head set, detector, telephone, coil, bicycle. Want gas engine, storage, radioson, audion, dynamo. E. Hough, Johnstown, N. Y.

EXCHANGE—22 cal. single shot rifle, pedometer, learners' telegraph outfit, electric engine, steam engine, for receiving set. A. Taylor, 105 E. 102d St., New York.

SALE OR EXCHANGE—Have 1 inch coil in A1 condition. Will sell for $3 or trade for Crystaloi or D. C. motor. K. Zinn, Delafield, Wisconsin.

WRITE for a list of articles I have for sale: audion, Multi-Fone, etc., will sell cheap. Max Kuhne, 94 River St., Hoboken, N. J.

HAVE REPEATING RIFLE and single barrel shot gun. Want good omnigraph or navy type loose coupler. C. E. Nichols, Cozadale, Warren County, Ohio.

WANTED—150 feet of aerial wire (No. 14) and rotary variable. Have Crystaloi type O and marble based perikon. Cash for Superior phones. W. O. Fitchett, Waverly, Va.

EXCHANGE—One coaster brake bicycle and pair Superior Brandes headset. Want a good two or four cylinder gasoline motor. Must be complete and A1 condition. Louis Jensen, 1217 Center St., Racine, Wis.

FOR SALE CHEAP—1½ H. P. combination gasoline engine, 2 and 4 volt 60 ampere hours and several 2 volt 10 and 2-20 ampere hour storage batteries, electric trains, wireless receiving outfit, ½-inch jump spark coils, quart gasoline blow torch $2, alcohol blow torch 50c. Enclose stamp. George Dietrich, P. O. Box 27, Cedarburg, Wis.

FOR SALE OR EXCHANGE—Knapp type S dynamo-motor, also one inch spark coil. What have you in the wireless line for sale or trade? Carl Caufield, 122 Leslie Ave., Niles, O.

WANTED—Sending and receiving apparatus. If interested write to Hyman Domash, 222 Cherry St., New York.

WILL TRADE Murdock loose coupler for three sections Murdock molded condenser. Harold Long, 912 Indiana Ave., La Porte, Ind.

FOR SALE—Large commercial helix costing $15, Massie key, 2 antenna switches, ½-inch coil, anchor gap, 1,000-ohm receiver head band, condenser, detector. Modern Electrics from 1911 to 1914. All for $9. Sam Frizzell, Duxbury, Mass.

FOR SALE—Four horsepower light weight Pope motorcycle with Presto lighting system for $60. All letters answered. J. E. Smith, 420 Forestrose Ave., Lancaster, O.

FOR SALE—Electro $7.50 loose coupler, bargain, $3.50; wireless key, 40c.; ½ K.W. transmitting condenser, $1.50; 50-ohm relay, 60c.; adjustable quenched spark gap, $2.25. All instruments O.K. Stuart W. Pierson, Carrollton, Ill.

SALE OR EXCHANGE—Microscope, $5 for sending set. E. Stahl, 1135 W. 110th St., Chicago, Ill.

FOR SALE—One Panoram Double postcard size, cost me $20, will sell it for $12. An 8x10 View Camera, with two plate holders and tripods, cost $35; sell for $15. A pair of opera glasses, cost $4, sell for $2. A 4x5 camera with plate holder, cost $12, sell for $6. A dark-room clock, cost $5, sell it for $2.50. One pair of day and night field glasses, cost $13, sell for $7. Carl Siehl, Ionia, Mich.

MY AD—In the March issue still stands good—look it up. Furthermore have a Brush auto for trade or sale, cheap. A1 condition. R. W. Williams, 826 First Place, Plainfield, N.J.

NEW RJ4 AUDION—Cost $20. Will sell for best cash offer. If interested write L. W. Houlroyd, 34 W. 50th St., Bayonne, N. J.

WANTED—Experimental wireless telephone outfit for small school; must be cheap. Robert Naylor, Box 927, Nanaimo, B. C., Canada.

WILL TRADE—27 cloth-bound books fiction stories for good spark coil, or anything of value. Robt. W. Parsons, Riverton, Ill.

FOR SALE—Unused "Electro" Mignon coupler and Murdock 3,000-ohm headset; make offer. T. R. Wiley, Piqua, Ohio.

FOR SALE—One pair of Electro Junior phones, are new, for $2 postpaid, or will trade for variable condenser. Harold Newman, 503 W. North St., Danville, Ill.

WILL PAY CASH for used or burned out DeForest Audion or amplifier bulb. W. S. Gould, 560 D St., San Rafael, Cal.

BRANDES NAVY PHONES, 3,200 ohms, in fine condition; used but short time; complete set cost $13, will sell for $8. Also have new Mignon selective coupler for $4.25; Mesco practice set, $1; small motor and rotary, $1; 75-ohm phone, 25c.; detector, 50c.; six electrical and wireless books. E. Runge, 164 Macon St., Brooklyn, N. Y.

WANTED—Mignon R L C 2 cabinet. Have complete 2,000-mile guaranteed receiving set minus phones, worth $40; speed lathe for wood and metal; I. C. S. Elec. Eng. library, etc. C. F. Young, Portsmouth, N. H.

WIRELESS TRANSMITTING and receiving outfit. Want twin-cylinder motorcycle engine, folding film camera, or sell for half price. Bert Speicher, 1903 Gaskell Ave., Erie, Pa.

SHAW MOTOR-BICYCLE—Almost new, runs good, price $60. Write Forest Axtell, Galt, Mo.

WILL PAY CASH for used or burnt out Audion bulb. Matt Jarosz, 3510 Narragansett Ave., Chicago, Ill.

FOR EXCHANGE—A 2,500-mile receiving set 6-volt 6-ampere dynamo, three storage batteries, water motor, 500-ohm receiver and ½-in. coil, $1.50. Want Audion or Audio-tron detector or ¼ to 1 kilowatt transformer with gap and helix. Kenneth Jennings, 569 Norfolk St., Mattapan, Mass.

WANTED—A good second-hand motor-bike engine; Shaw or any good make; must be cheap. E. Haugerud, Scappoose, Ore.

WILL SELL—1-in. spark coil, $2.50, and 31 plate Blitzen variable without case for $2; might sacrifice Brandes Superior Headset for $3. Ole Horgaard, 91 Marion St., Brookline, Mass.

SALE OR EXCHANGE—I. C. S. Complete Elec. Eng. Course with bound vols. (1915 edition), 1-1 K.W. variable transf. 15,000 volt sec. 110 prim. not cased, Winchester 1895 model take down 30 Gov't rifle with 100 shells. Want: Brandes Navy phones, Audion bulbs, good or broken; variable condensers, 110-volt A. C. motor fractional H.P. Crystaloi detector, type D rec. transformer. Wm. G. Wagner, Box 19, Big Creek, Cal.

HAVE reel of film, sell cheap; will trade; stamp must be enclosed. Kenneth Woodward, 24 Lenox, Uniontown, Pa.

FOR SALE—Pair of tubular ice skates, brand new, with shoes attached, size of shoe No. 6; cost $11, will sell for $8. Also have electro-port generating set, will sell for $4. Geo. Schadt, 938 First Ave., New York City.

EXCHANGE—Oliver typewriter, No. 5; ½ K.W. transformer, high tension condenser. Want wireless goods, printing press, mandolin, or what have you? Will exchange separately. Write quick for particulars or make me an offer. T. Vandervort, Harpers Station, Rose County, Ohio.

EXCHANGE—Fine 700 stamp collection in album, 33 arrowheads, ¼-in. spark coil, tuning coil. Want wireless, especially headset or variable. L. Rosa, Tremonton, Utah.

SELL OR TRADE—1 extra ice skate; 27 numbers Boys' Magazine, Dec., 1913-Feb., 1916. James Kincaid, 128 S. 8th St., Durant, Okla.

WHAT AM I OFFERED for a "Powers" moving picture machine complete Rheostat, movie lens and stereopticon lens and 18 reels of film. Ford, 389 Tremont Ave., Orange, N. J.

WILL PAY CASH for Audion bulb; must be in good condition; state price. D. A. Mason, 817 N. 13th St., Tacoma, Wash.

HAVE THINGS TO EXCHANGE for good long distance wireless receiving set. H. W. Littlefield, Whitman, Mass.

FOR EXCHANGE—Two .22 Cal. rifles, some electrical and wireless apparatus. Selmer Wick, Hendrum, Minn.

FOR SALE—1-in. coil and condenser, $5.50; 3x5 New Kelsey Press, $4.25; 2 Crown telephones, $3; 6-v. motor-dynamo, $3. Other bargains. Write, Seth G. Smith, 49 Institute Road, Worcester, Mass.

AUDION DETECTOR—In excellent condition, for sale or trade at a reasonable price; type R.J.4, Standard filament; used about two months; high voltage batteries included. Write, Noah Gray, 3151 Detroit Ave., Toledo, Ohio.

EXPERIMENTERS—Will sell good second-hand telephone magneto generators in fine condition at 75c. a piece, not postpaid. Perform numerous experiments with them. R. Gerhart, 547 W. Chestnut St., Lancaster, Pa.

FOR SALE—First offer of $4 takes 1 K.W. high potential condenser. Edward Law, Sycamore St., Clarksburg, W.Va.

FOR SALE OR EXCHANGE—Camera, 6½x8½, latest model long focus, back and front focus, swing back and side movement, and a complete outfit with four lenses and auto flash machine with a 25-ft. auto release; articles are too numerous to mention here; cost $180, sell for $75 cash, or exchange, for a medium-size screw cutting lathe, with tools, chuck, etc.; must be in first-class condition. My outfit is positively brand new. I also have "Modern Electrics" Magazine from Sept., 1908, to Sept., 1915, all in first-class condition; what am I offered? Call, write or phone from 10 to 12 A.M. or from 8 to 10 P. M. any day, 6573 E. N. Y. J. G. Fitchett, 49 Ashford St., Brooklyn, N. Y.

A FIRST CLASS WIRELESS OUTFIT for sale cheap. If interested write W. H. Cobb, Burlison, Tenn.

BARGAINS OFFERED—E. I. Co. 100-mile transformer coil with vibrator for $5; wall tent 10x12, 12-oz. duck with 12-oz. fly with poles, $10; $5 Erector set complete for $3. All goods in good condition. F. O. B. Richard Orom, 144 Montgomery St., Newburgh, N. Y.

HAVE Cyclopedia of Applied Electricity, six volumes, 2,800 pages, in good condition; cost new $18; will exchange for anything electrical. What have you? Frank Draucker, 506 E. Church St., Lock Haven, Pa.

HAVE 3A Special Eastman kodak, also .22 Winchester rifle. Want 1 K.W. sending set complete. What have you? R. Manuel Quick, Montford, Wis.

WANTED—An electric auto horn; a single-cylinder motorcycle engine; good or burnt out Audion bulbs; headset and postcard kodak. Harry Wellard, Roundup, Mont.

TRADE—Type XX Turney variable condenser, cost $5, never used. Want lightning switch and stranded copper aerial wire or phones. Tom Sides, Selma, Cal.

FOR SALE—Audion complete, with high voltage batteries Hudson X grade bulb; storage battery 6-volt 80-ampere; variable condensers; 2,000-ohm headset ½ K.W. transformer; typewriter; good camera with full equipment; taped receiving transformer 1,600 waves; receiving transformer 8,000 waves with dead-end tap. Many other things. Write and give your price. All answered. Louis E. Krieg, 134 North School St., Glovers-ville, N. Y.

EXCHANGE—New mandolin, cost $4, for loose coupler or Crystaloi detector. Charles Gutman, 145 Hull St., Brooklyn, N. Y.

EXCHANGE—Punching bag outfit, cost $20; Winchester .22 repeater and accordion. Want wireless goods, cornet, guns, or what have you? All letters answered. Write, Anton Rank, Buffalo Centre, Iowa.

FOR SALE—$5 set of Meccano, $2; $2 wool bathing suit, $1; $1.50 electric motor, 75c. Also other boys' articles. Postal brings list. H. Treubig, 1350 Putnam Ave., Brooklyn.

$18, MUST SELL—For a bargain, $18, circumstances force me to sell my supplies: 3 Geissler tubes, 2 lilliput connectors, 1 voltammeter, 1 Bunnell's learner's set, 1 D. P. D. T. switch, 1½-in. spark coil, 1 small condenser, 1 dry cell flashlight, 12 small and large binding posts, 24 large and small switch points, 1 1-32 tap, 1 9-32 tap, 1 tap holder, 2 switch levers, 1 adapter, 150 ft. No. 18 wire, 1 breezer fan for 110 volts or 220 volts, 1 bugle, 1 watchcase buzzer, 1 Monarch Visible typewriter No. 3 in first-class condition, it's worth the money alone. I will sell the lot for $18, and throw in an extra supply. The first check or money order and express charges get it. Write, John Stine, Gila Bend, Ariz.

TELEGRAPHONE talking head (complete) will be exchanged for any of the following instruments: A Weston or Keystone voltmeter, galvanometer, variable condenser (rotary), dynamo, or what have you? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

FOR SALE—Electro Importing Co. 2,000-ohm head-phones, two galena detectors, junior fixed condenser, fixed condenser, professional loose coupler, Gernsback variable condenser, lightning switch and aerial; also repeating shotgun; all new; cheap for quick cash, or will trade. Address E. M. Pogue, Berry, Ky.

COMPLETE RECEIVING OUTFIT used only one week; long wave length loose coupler, commercial marble base detector, condenser, headband, receiver and cord. First remittance of $5.50 takes this outfit. Leonard Victor, 306 W. 121st St., New York.

SALE OR EXCHANGE—Excellent portable sending and receiving set; also other wireless instruments. Want pump gun and 1 K.W. apparatus. Herbert Maus, 119 W. Fox St., Rome, N.Y.

FOR SALE—A small chemical laboratory with 40 Reagents for experimental purposes; also a small electrical "lab." The both together should make an ideal addition to your den for fun and knowledge. Write for details and prices. Address P. O. Box 381, Monticello, N. Y.

FOR SALE OR EXCHANGE—One brand new printing press and complete outfit, containing 6 fonts of type; cost $40; first good offer takes it; 1 violin and outfit, cost $50; 1 Underwood visible typewriter in perfect condition; looks brand new. Write quick. R. C. Arnaud, Keene, N. H.

MURDOCK 2,000-ohm phones, $3; 3 vol. I. C. S. locomotive engineering course and set of air-brake models, $8, or exchange for wireless goods. N. Knight, 59 Lawrence St., Malden, Mass.

FOR SALE OR EXCHANGE—E. I. 1-in. spark coil, $2.50; Murdock 2,000-ohm phones, $2.50; 1,500-metre loose coupler, $2.25; E. I. loader, $1.75, in fine condition; Racine ($8) 1-16 H.P. grinder and buffer practically new $6.35. Want a Murdock variable and Brandes transatlantic phones. All letters answered. O. E. Soper Beta Phi, Durham, N. H.

WANTED—Jan. '16 number Popular Science Monthly; state your price. H. A. Johnson, DeKalb, Ill.

E. I. CO. TRANSATLANTIC PHONES, new, $3.50; trade receiving set for motorcycle. Schwarzburg, 1019 Kentucky St., Quincy, Ill.

FOR SALE—Four electrical I. C. S. books, $5; electric power transmission, $1; Iver Johnson single shotgun, $2.50. A. C. Smith, Patchogue, N. Y.

EXCHANGE—Telephone receivers, transmitters, induction coils, Ringer coils, magnetos, and complete telephones in working order, desk and wall type, switchboard drops, jacks, plugs, keys, relays, etc. Want ½ or ¼ K.W. transformer, wireless set, lathe, or what have you? Box 226, Oelwein, Iowa.

EXCHANGE—$3.50 bamboo trout rod, reel, and $2.50 tennis racket. Want loose coupler, condenser and lightning switch. William Schick, 1822 Palmetto St., Brooklyn, N. Y.

FOR SALE—Receiving apparatus, including receiving set with audion detector; also panel set. Descriptions upon request. J. A. Crowdus, 5047 Washington Ave., St. Louis, Mo.

TRADE—Have 2-cylinder 14-H.P. auto engine, coil, carburetor, oiler, 1½-H.P. Detroit marine engine, coil tank, carburetor; 2-cylinder air compressor, direct current 14-amp. dynamo. Want ¾ K.W. transmitting set complete; complete audion receiving set. E. L. George, 702 Main St., South Weymouth, Mass.

EXCHANGE—New high grade Waltham watch for wireless apparatus; also other watch. Write, Leo Club, Box 398, Phenix, R. I.

FOR SALE—Brand new Colby receiving transformer, bargain, $4; new oscillation transformer, $4; moulded condenser, $1; rotary gap parts, $1.50; loading coil 5,000 meters, $1.75; new bare-wire tuning coil, $1.50; adjustable sending condenser, $1.25. Eugene C. Braatz, Lowellville, Ohio.

SWAP—Mandolin, guitar, harp, almost new, for Brandes Superior Phones in good condition. Have other swaps. Karl Bowman, Lumberton, N. J.

AUDIONS—Have a few new and burnt out DeForest Audion bulbs. Cahn, 215 Greene St., New York.

FOR SALE—New wireless receiving outfit, consisting of three slide tuner, galena detector, fixed condenser, potentiometer, 1,000-ohm receiver, buzzer, price $5. Fonda McCook, Sumner, Ia.

FOR SALE—Mignon R. L. C. 3 special cabinet, $25, express prepaid. Leon Bartholomew, Fisk Coal Co., Jackson, Mich.

LAUNCH MOTOR, 3 horse Gray with carburetor and ignition equipment, $25; Steven's Favorite rifle (now $6.75), with case, $4; fencing foil and mask, worth $6.50, $4. A. Newman, 685 West Ferry, Buffalo, N. Y.

AC MOTOR, 110-volt. 1-20-H.P.; will exchange for double filament DeForest Audion bulb. William Olsen, 229 94th St., Brooklyn, N. Y.

FOR SALE OR EXCHANGE—200 magazines, phonograph motor, photograph apparatus and Mead bicycle pump. Exchange for electrical or wireless goods; prefer headset or audion. Alva Allen, 1215 North Noland, Independence, Mo.

FOR SALE—To highest offer, new ½-K.W. transformer coil with vibrator, cost $8; postage extra. Write, Caesar Poreari, 566 Herkimer St., Brooklyn, N. Y.

FOR SALE OR EXCHANGE—1 2-in. bull dog spark coil with spark gap, $6; 7 Geissler tubes and 2 fancy tubes, $4.50; Tesla coil, $4; 1 1,000-ohm receiver (new), $1; 1 75-ohm receiver with headband, 75c.; 1 aluminum bar sounder and platinum point key (new), $2; 1 telegraph set (new), $1.50; 1 postcard projector, $1; 4 Leyden jars and discharger, $2; these goods are all in good condition; 1 ½-in. bull dog spark coil in fair condition, $1.50. Will take cash or make deal for Bosch Magneto for Ford. R. C. Bright, Waucoma, Ia.

FOR SALE OR EXCHANGE—Will sell omnigraph with extra dials, $1; spark coil 1 in., $3; gap, 30c.; adjustable condenser (sending), $1.50; Tesla coil, $3; 75-ohm relay, $3; fixed variable condenser, $1; Radioson detector, $3.50; Gernsback rotary variable condenser, $3; all E. I. Co. goods. Thordarson step down transformer, cost $7, $4; AA Crystaloi, $4; two Duck detectors, $1; pair rubber ear pads, 50c. Will sell all $46 worth for $20, or trade for ½-K.W. Thordarson transformer and condenser. Will trade part for Murdock or Blitzen 43-plate variables, or Murdock ½-K.W. condenser. Paul G. Busey, 911 W. Nevada St., Urbana, Ill.

WANTED—For cash, a used motorcycle cylinder (for the "Detroit" motorcycle preferred), 3¼x3¼, or motorcycle engine of about 4 H.P. Need not be in running order. John Odill, Box 492, Norway, Mich.

Opportunity Exchange

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.
Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertiseing agency.
Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.
Advertisements for the June issue should reach us not later than May 1st.
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HAVE YOU SEEN A COPY?—Amateur Photographers' Weekly, $1.50 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 40c. Amateur Photographers' Weekly, 915 Schofield Bldg., Cleveland, Ohio.

BOOKS—Scientific and wireless supplied. Let us know what you want and we will quote you. Experimenter Pub. Co., 233 Fulton St., New York City.

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DRAWINGS MADE FOR INVENTORS. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

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MISCELLANEOUS

SMALL GASOLINE and steam engines, engine castings, dynamos, motors, storage batteries, electric light plants (200 watts up), tools, gears, pulleys, etc. Catalogue and circulars for 5c. Dynamic Manufacturing Co., First National Bank Bldg., Chicago.

FILMS DEVELOPED FREE—Send negative for sample print and particulars. New Lex. Novelty Co., New Lexington, Ohio.

WE ANALYZE EVERYTHING—Guaranteed formulas furnished by experts. C. Laboratory, 637 Madison Ave., New York.

STAMPS—100 all different free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

SOMETHING NEW!—Renew dry batteries a new way. Formula guaranteed 25c. No stamps. Alexander E. Poreda, Box 31, Greenville, Conn.

FOR SALE—Moving picture machine and twelve films, $85. Harold Braswell, P. O. Box 1851, New York.

WHO'S THAT CALLING? Get a copy of "Radio Stations of the World," a book that gives name, location and classification of every wireless station in the world. Price 35c. with postage on 1 lo. extra. Experimenter Pub. Co., 233 Fulton St., New York City.

PATENT ATTORNEYS

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D.C.

PATENTS SECURED OR FEE RETURNED—Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

JOHN M. McLACHLEN, attorney-at-law—Patent causes. Union Trust Bldg., Washington, D. C.

AMERICAN AND FOREIGN PATENTS obtained. Before selecting an attorney, write for our solid, instructive advice; join the ranks of happy inventors. Correspondence Office, 125 E. 23d St., New York City. F. V. Winters, Reg. Patent Lawyer, New York City & Washington, D.C.

IDEAS WANTED—Manufacturers are writing for patents procured through me. Three books with list hundreds of inventions wanted sent free. I help you market your inventions. Advice free. R. B. Owen, 130 Owen Bldg., Washington, D. C.

WIRELESS

2 K.W. MARCONI 60-CYCLE TRANSFORMER, also 1½ K.W. commercial closed core transformer, condensers and gaps. Best condition. Harry Weber, 1113 N. Walnut St., Canal Dover, Ohio.

BLUEPRINTS of Audion amplifying coil, tikker, 500-cycle alternator, 50c. each. D. R. Canady, Suite 80, Oppman Terrace, Cleveland, Ohio.

GALENA, best grade obtainable, 20c. oz., and postage. C. M. Cardeza, 311 S. 10th St., Philadelphia, Pa.

STANDARD APPARATUS—Multi-Audi-Fones, Audions, Crystalois, Hi-Tone Rotaries, Mignon Apparatus, Brandes Phones. Used apparatus bargains. Arthur B. Church, Lamoni, Ia.

WIRELESS STATION photographs—Arlington, Tuckerton, Sayville, 10c. Going fast, get yours now. Dunkle & Ballou Co., 2 Truesdel St., Binghamton, N. Y.

WE BUY high grade, used wireless apparatus in good condition. State make, condition and lowest price. M. Mueller, 18 Devonshire St., Boston, Mass.

TESTED DETECTOR, 15c.; cat whiskers, 3 for 5c. Patch Bros. Wireless Co., Klemme, Ia.

RUBBER COMPOSITION receiving condenser, 4½x2⅛, 50c.; postage, 8c. Hook ups, 3 for 10c. Vance & Vance, 155 Muntz St., Hillsboro, Ohio.

BEFORE you try to wind secondaries for a coil or transformer get our prices; we can save you time and money. State your wants plainly. Eureka Secondary Co., 6937 S. May St., Chicago, Ill.

NEW ILLUSTRATED CATALOG—2,500 meter loose couplers $5, 43 plate variables $3.75; other bargains; stamp for catalog. Cliff Manufacturing Co., Brookfield, Mass.

TEST SILICON—10c. oz. Sent day order received. Gress, Pitman, New Jersey.

ALL KINDS, all makes of radio apparatus are given as premiums for selling our fast-selling Ballco Rubberoid Aprons. Send stamp for particulars or 25c. for sample apron. Ballco, Buckland, Conn.

Wireless Experimenters should read this magazine. *See top of page 70 for details.*

WITH REGULAR BAND

Complete Double Set

2000 Ohms - - $4.00
3000 Ohms - - 5.00

With Coronet Band
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WITH CORONET BAND

Murdock Wireless Receivers

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This PROVES that we are delivering REAL wireless receivers which fully satisfy *99 out of 100* wireless operators in *sensitiveness*, *appearance* and *value*.

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YOU CANNOT BUY BETTER RECEIVERS AT THE PRICES. YOU MAY PAY MORE BUT GET LESS IN ACTUAL VALUE. IT'S YOUR TURN TO TEST OUR CLAIMS. DELIVERY AT ONCE. OUR CATALOG IS FREE.

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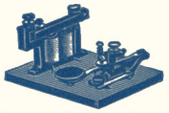

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We set the standard in complete receiving and transmitting outfits. Don't buy until you see our Catalog.

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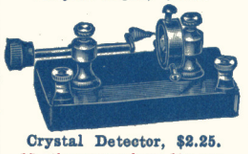

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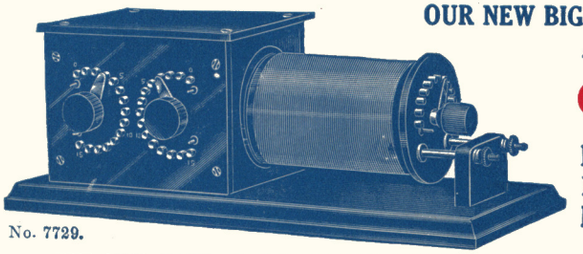

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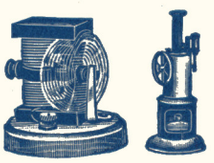

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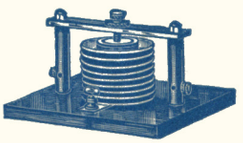

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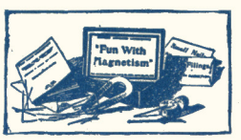

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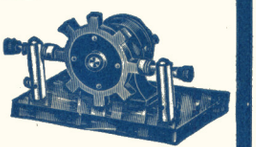

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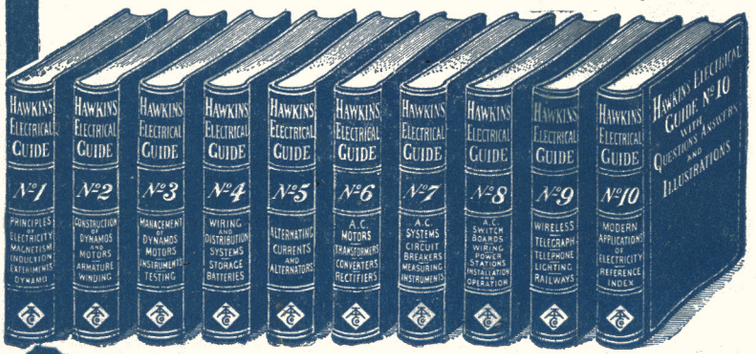

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